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Studies on the Reproduction and Growth of the Blunt-nosed Minnow, *Hyborhynchus notatus* (Rafinesque)

By James R. Westman

THE blunt-nosed minnow is one of the many species of Cyprinidae which have a wide distribution over the eastern United States and Canada. Due largely to its high degree of environmental tolerance and to its partial subsistence on herbivorous diet, the species is valued as a forage fish.

Data on the life history of the species have been presented by Van Cleave and Markus (1929), Cooper (1935), and Hubbs and Cooper (1936). Brief notes on spawning and length of breeding season appear scattered throughout literature.

The present studies consist of observations on the reproduction and growth of single pairs and isolated groups of blunt-nosed minnows which were kept in compartment-ponds of approximately 500 cubic foot capacity. The investigations were carried on at the Cooperative Fish Hatchery, Powder Mills Park, Monroe County, New York, and the writer wishes to acknowledge his indebtedness to Mr. H. C. Markus of the United States Bureau of Fisheries, whose cooperation made the work possible.

Procedure

From a number of mature minnows taken in the field during the early part of May, 1934, one male and three females were selected for pond I and one male and one female for pond II. A number of individuals of various sizes and stages of maturity were placed together in pond III while a fourth group, comprising a dozen minnows ranging in size from 15 to 35 mm., standard length, was placed in pond IV. Groups III and IV were taken in the field during the preceding November and the latter group was considered to represent the young of the year. Pieces of large field tile were placed on the bottom of each pond to serve as spawning sites and a constant supply of filamentous algae was maintained in the pools throughout the period of study.

Reproduction

Sexual Dimorphism.—Mature males could be easily distinguished from mature females by their much greater size. The former were more than 63 mm. in standard length while the latter ranged in size between 44 and 55 mm. These lengths for adult blunt-nosed minnows appear to be typical for the Rochester area, although larger size is often attained in other districts.

Nuptial tubercles were first noticed on the males during the first week of May, or approximately 4 weeks previous to the time of spawning. As the spawning season approached, the males became more darkly pigmented on the head and fins, and over the dorsal region of the body; while a rufous tinge, more intense in the predorsal region, appeared in the darkened area. Accompanying this change in coloration was a thickening of the membrane surrounding the dorsal fin and a thickening of the epidermis overlying the

scales on the predorsal section of the back. In males which were nurturing eggs, the latter thickening became roughened to form a heavy, rugose pad which failed to develop in males that were prevented from spawning.

PREPARATION OF THE NEST.—For several days previous to the time of spawning, the males were actively engaged in preparing nests. The locations selected were the slightly curved undersurfaces of the field tile, which offered sufficient area for the eggs and allowed enough space beneath for the activity of the male.

The preparation of the nest by the male has been described in detail by Hubbs and Cooper (1936: 77), who included the following note:

> After the site was definitely selected, he began constructing the nest—a long task which consisted chiefly of making a shallow cavity in the bottom underneath the object where the eggs were to be laid. In excavating the cavity, the male cleaned out the silt, sand and small pebbles by violent sweeps of the tail, and pushed out stones, sticks and other larger objects with his horny snout. In cleaning that part of the under surface of the chosen object which forms the roof over the cavity, the male used his mouth and his spongy back. The entire process of selecting the nesting site and building the nest required an hour or two.

In the present study it was discovered that males which had been isolated in aquaria would prepare a nest and tend it faithfully for a period of a week or more in the absence of the female. It seems evident therefore that the presence of a ripe female is not necessary to stimulate the male into nest-building activity.

SPAWNING.—A nest of 408 eggs appeared in pond II on May 29. These eggs averaged 1.45 mm. in diameter and were deposited in a single layer on the underside of the tile. The parent male remained in attendance. Subsequent deposits appeared in pond II on June 3, 10, 18, 26, 28, and 30, and on July 5, 10, 14, 20, and 24. The eggs of each batch varied in number from 40 to 408 (Table I) and were always deposited during the night. At all times observed, the male fish actively resented any approach to the nest by either males or females during the daylight hours. It has been shown by Hubbs and Cooper (1936), that in some instances daytime spawning will occur. In pond I, where one male was segregated with three females, 12 batches of eggs appeared during a period of 33 days. The deposits in these instances were frequently much larger than those made in pond II—the number of eggs present on a tile at any given time during this period varying from 300 to 1500 instead of 40 to 408. The number of eggs in the single nest in pond III reached 2,300 which were occasionally deposited in two layers.

The contrast between the sizes of the egg deposits in ponds I and II, plus the fact that the same number of deposits were made in both, i.e. 12, would indicate that not only will several females spawn with a single male, but also that more than one female will spawn with the same male during a single night. The data show that the spawning season of the captive minnows did not exceed a period of two months either for groups or for the isolated pair.

Contemporary field observations indicated that during the summer of 1934 the spawning season in nearby districts did not extend longer than seven weeks in any particular locality, although dates for the spawning period differed in some areas. The breeding season of the blunt-nosed minnow in

the Rochester area thus appears to be considerably shorter than that found to obtain for this species in Illinois by Hankinson (1920) whose dates are May 1 to August 26. Hubbs and Cooper (1936) give the latter part of May to the latter part of August as the period of spawning for Michigan while Wright and Allen (1913) found nests between May 15 and July 15 at Ithaca, New York.

Incubation and Mortality of the Eggs.—All eggs observed became eyed after a period of 3 to 5 days on the tile and hatched after a period of 6 to 10 days. Temperatures of the ponds during this time are given in Table I.

While dead eggs were never found in the nests, a loss in number was occasionally noted. Such a loss occurred from the first batch deposited in pond II, and in the same pool the last five batches of eggs failed to hatch. In noting a similar phenomenon with the black-head minnow, Markus (1934) found that such eggs had dropped from the tile and were undeveloped.

It is quite possible that dead eggs are removed from the tile by the activity of the male, as experiments revealed that eggs which had been killed by puncturing would remain on the tile only when the parent male was removed from attendance. It has also been noted by the writer that in the mud-minnow, *Umbra limi*, the guarding female will pick out and devour undeveloped eggs.

Table I. Egg Deposits Made by the Female in Pond II and Their Mortality, With Water Temperatures

Date	Number of eggs deposited	Number of eggs hatching	Percent Mortality noted	Temperature (centigrade)
May 29	408	372*	9.1	19
June 3	400*	400*	0*	24
June 10	300*	300*	0*	24
June 18	250*	250*	0*	23
June 26	250*	250*	0*	23
June 28	100*	100*	0*	25
June 30	150*	150*	0*	25
July 5	100	0	100	22
July 10	70	0	100	23
July 14	150	0	100	27
July 20	80	0	100	26
July 24	40	0	100	26

* Approximate.

The presence of the parent male was found to be further necessary to insure a continuous movement of water over the eggs and to keep the nest free from sediment. In all instances observed, eggs which had not reached the eyed stage in development would die within twelve hours after the parent male was removed from attendance.

The total number of eggs produced by the female in pond II was estimated to be 2,298. Of this number approximately 476 failed to hatch. Additional data on the egg production of *H. notatus* were obtained by counting all the eggs present in the ovaries of 10 mature females collected April 23, 1933. These eggs were always in several different stages of development, and, in the 10 specimens examined, varied in number from 1,743 to 2,223, the average per fish being 2,005.

Growth

Mortality of the Young.—The newly hatched young were 5 mm. long at birth and appeared in groups near the surface of the water 8 days after hatching. It soon became obvious that more young were appearing in pond II than in pond I, despite the fact that more than twice as many eggs appeared to be hatching in the latter. This discrepancy continued but when the ponds were drained the following November, the number of recovered young from the two pools was approximately equal, or about 300 minnows per pond. No definite cause for this mortality could be discovered.

Growth of the Young.—Individuals from the earliest eggs in pond II had attained a standard length of 12 mm. two weeks after hatching, and a length of 37 mm. by the following December. Individuals from the deposits made in late June had attained a length of only 15 mm. by the following December. It is to be observed that the sizes of these captive young correspond with the lengths of the minnows constituting group IV, when that group first came under observation.

It has been noted by Hubbs and Cooper (1936: 81) that "Under favorable conditions, those young which hatch early in the spring reach a sub-adult size by the end of their first growing season and spawn early in their second year . . . When propagated in a pond where food was scarce, the young were very small at the end of the summer; at the prevailing rate of growth, few of them would have reached an adult size in their second year of life."

Dr. Embody has reared the blunt-nosed minnow in fertilized ponds at Ithaca, New York, and from a total of 1,009 young, not more than 10% reached a standard length of 55 mm. during their first summer of growth. Van Cleave and Markus (1929) found that in a single collection of 369 specimens of the blunt-nosed minnow taken in Illinois, the young of the year ranged in size from 13 to 42 mm. It seems probable therefore, that under normal conditions, the young of the year do not attain a sub-adult size during the first summer of growth.

Maturity.—Growth and maturity were studied for 11 specimens recovered in late September out of the 12 individuals which had constituted group IV in May, 1934. Seven of these specimens proved to be immature males with an average length of 57 mm., while the remaining 4 were females with well developed ovaries and an average length of 50.2 mm. Thus, under the present conditions, females reached a sub-adult stage of maturity in their second year, while males of similar age were still immature. According to the investigations of Hubbs and Cooper (1936), however, it is evident that the age of maturity may vary from one to three years, depending on the amount of available food and the length of the growing season.

In December, 1934, several individuals of the original spawning groups were still living and in good condition. The two surviving females in pond I averaged 57 mm. in standard length and their ovaries were well filled with eggs. The female in pond II was 63 mm. long, with similarly developed gonads; while the male from the same pool had a length of 74 mm. This would indicate that the blunt-nosed minnow can pass through at least 2 spawning seasons and possibly a third.

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Note on the Sex Ratio of the Yellow Perch in Douglas Lake, Cheboygan County, Michigan[1]

By THOMAS H. WELLER

DURING the summers of 1936 and 1937, in connection with a parasitological study, 502 yellow perch (*Perca flavescens* Mitchill) were examined from Douglas Lake, Cheboygan County, Michigan. As perch under 10 cm. in total length were found not to contain the nematode being studied, no effort was made to obtain specimens under that size limit. In 1936, it was noticed that there was an extremely unbalanced sex ratio with a very large predominance of females. Therefore, during the past summer, records were kept in hope of determining the sex ratio of the perch in the particular part of the lake being studied.

Fish were taken from the eastern end of Douglas Lake, chiefly in the South Fishtail Bay area. In this region, the shore is characterized by a gently sloping sand shelf of varying width, which at a point where the water is about two meters deep, drops off abruptly to a depth of about ten to twelve meters. For the most part collections were made at the drop-off, using gill-nets, trammel-nets, and hook and line; but the shoal area near the drop-off was also worked with fyke-nets and seines. Using this gear, 196 perch were taken in 1936 and 308 in 1937; these measured from 10.0 to 18.5 cm. in total length with most of the fish falling between 12 and 15 cm.

During the summer of 1937, the observation of the extremely unbalanced sex ratio, made during the previous summer, was confirmed. Of the perch taken in 1937, only 3 were males and 305 were females. From these data, it appears that for the particular habitat studied, namely, in the vicinity of the drop-off at the east end of Douglas Lake, the ratio of males to females is approximately 1 to 100.

[1] Contribution from the University of Michigan Biological Station.

An attempt was made to determine whether this ratio was due to some peculiar annual variation or whether it was characteristic of Douglas Lake. Excellent material for checking this point was provided by a series of perch taken from the same location in the summer of 1921 by Drs. Carl L. Hubbs and C. W. Creaser, and preserved in the collections of the Museum of Zoology of the University of Michigan at Ann Arbor. (See Table I for summary of size and sex distribution of all fish studied.) On sexing the 1921 material and classifying it into size classes, it was found that of the 101 perch 10 cm. or

TABLE I. SIZE AND SEX OF PERCH STUDIED

Size class	Number specimens 1921		Number specimens 1936	Number specimens 1937	
(Total length in cm.)	♀	♂	(Both sexes)	♀	♂
5.0 – 5.9	3	8	..	..	..
6.0 – 6.9	47	49	..	..	..
7.0 – 7.9	1	..	..	..	..
8.0 – 8.9	1	..	..	..	..
9.0 – 9.9	4	4	..	..	..
10.0 –10.9	36	..	7	5	..
11.0 –11.9	37	1	32	14	..
12.0 –12.9	14	..	54	52	2
13.0 –13.9	7	..	48	79	..
14.0 –14.9	2	..	29	61	1
15.0 –15.9	3	..	18	51	..
16.0 –16.9	..	..	6	29	..
17.0 –17.9	1	..	1	12	..
18.0 –18.9	..	..	1	2	..

longer, 100 were females, whereas only 1 was a male. This finding checks remarkably well with that for 1937. However, in the smaller size classes the ratio was approximately equal; of fish in the 6 to 7 cm. class, 47 were females and 49 were males. As will be shown later, these fish belong in the 0 age-group and must be considered separately from the larger fish. (See Table II for sex composition of individual catches.)

TABLE II. SEX COMPOSITION OF INDIVIDUAL CATCHES IN DOUGLAS LAKE, MICHIGAN

Date Collected	Place	Method Used	Size Limits (Overall length)	Females	Males
8/16/1921	Off Log Lab.	Seine	9.0–17.3 cm.	90	8
8/17/1921	Off boatwell	Line	10.6-15.9 cm.	15	0
8/21/1921	Off main dock	Seine	5.7- 7.1 cm.	50	57
6/27/37	Grapevine Pt.	Line	12.0-16.0 cm.	13	1
6/30/37	Off boatwell	Line	11.0-16.5 cm.	19	0
7/1/37	Grapevine Pt.	Gill-net	14.0-16.5 cm.	18	0
7/2/37	Grapevine Pt.	Gill-net	12.5-15.5 cm.	7	0
7/2/37	Boatwell	Line	12.5-16.0 cm.	14	0
7/5/37	Boatwell	Line	12.5-15.0 cm.	13	0
7/8/37	Grapevine Pt.	Line	11.5-15.0 cm.	25	0
7/12/37	Boatwell	Line	10.0-14.0 cm.	9	0
7/13/37	Grapevine Pt.	Line	10.0-17.5 cm.	34	0
7/18/37	Main dock	Seine	10.5-15.0 cm.	10	0
7/20/37	Off boatwell	Line	11.0-18.5 cm.	10	0
7/21/37	Pine Pt.	Gill-net	12.0-16.0 cm.	18	0
7/22/37	Boatwell	Line	11.5-13.0 cm.	14	1
7/25/37	Grapevine Pt.	Line	12.0-15.0 cm.	27	0
7/25/37	Boatwell	Line	11.5-13.0 cm.	8	0
7/27/37	Boatwell	Line	12.0-16.0 cm.	36	1
8/4/37	Pine Pt.	Fyke-net	15.0-18.0 cm.	30	0

A small number of scale examinations made by the writer in 1936 indicated that perch about 13 cm. in length were 3 years old, and those about 15 cm. in length were 5 years old. Similar conclusions may be drawn from the unpublished data obtained by Drs. Hubbs and Creaser in 1921 (see Fig. 1). It is thus apparent for the particular habitat studied, namely the vicinity

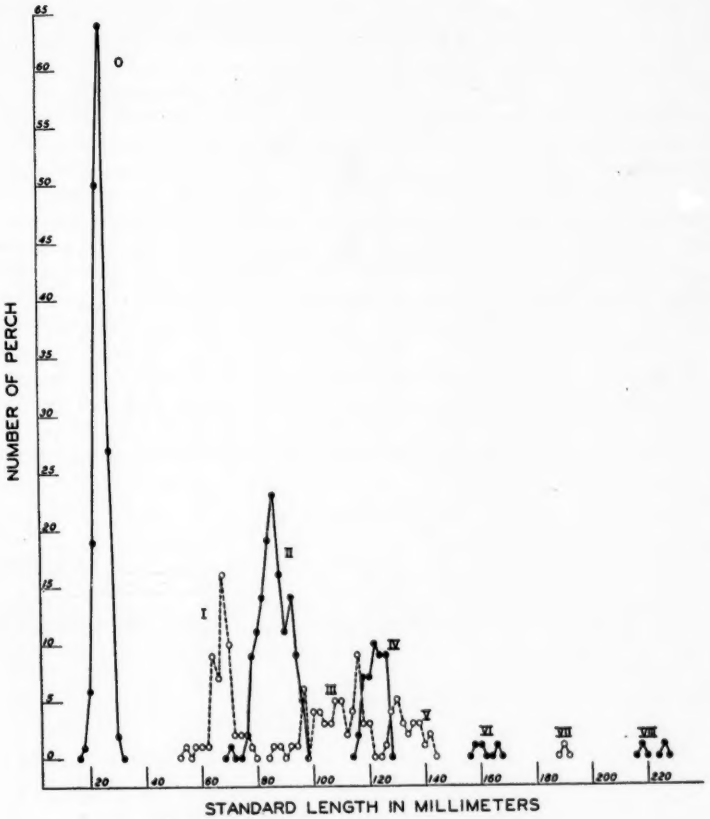

Fig. 1. Age groups of Douglas Lake perch.
(Based on studies by Hubbs and Creaser.)

of the drop-off at the east end of Douglas Lake, that in perch of the O group the sex ratio is approximately equal, whereas in those of Group II and all older ages, the population is composed chiefly of females. These data are at variance with those previously reported for the perch. Using a graded series of gill-nets to take random samples of perch in Vilas County, Wisconsin, Schneberger (1935) found the ratio of females to males to be 1:1.26 in Nebish Lake, but a ratio of males to females of 1:1.31 and 1:1.40 in Weber

and Silver lakes respectively. In exterminating the perch population of South Twin Lake, Otsego County, Michigan, through the use of gill-nets, poison, and dynamite, Eschmeyer (1936) obtained a very large and representative sample in which the proportion of females to males was 74 to 100. It was also determined that the young fish were dominantly males and the older fish dominantly females.

Several explanations may be advanced for the results obtained in Douglas Lake. In the first place, as females are usually larger than the males, a predominance was to be expected, since perch under 10 cm. in length were not desired. However, this point alone does not appear to account for the extremely unbalanced sex ratio. The three males taken during the 1937 season measured 12.0, 12.5, and 14 cm. in overall length, which would seem to indicate the presence of a large group of males which were longer than 10 cm. It is possible that due to some unknown cause, a large percentage of the males die at the end of the third year. A second explanation involves the assumption that during certain parts of the year there is a segregation of the sexes, and that older males would be found either in deeper water or in a different part of the lake. A third explanation must include the possibility that there might be a reversal of the sexes. This question is left open, subject to further study. In such a study, it will not suffice to consider a whole lake as a unit as has previously been done, but it will be necessary to examine the sex ratio in each of the various habitats within the larger unit.

The writer wishes to express his appreciation to Dr. Carl L. Hubbs for his helpful suggestions and for the use of unpublished data on the perch of Douglas Lake.

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A List of the Fishes of the Licking River Drainage in Eastern Kentucky

By Wilfred A. Welter

LITTLE work has been done on the vertebrates of eastern Kentucky. This has been due to the isolation of the region caused by the mountainous condition of the country and the lack of suitable roads. Furthermore, most of the colleges are located in the central and western sections of the state. As a result, few biologists have had easy access to the eastern section.

During the past five years the writer, assisted by his students and associates, has been making collections of fishes from various streams in the Licking River drainage. A number of these fishes are new for the drainage system and it was thought desirable to bring together in a single list all the species known to occur in the Licking River and its tributaries. Most of the fishes collected by the writer are in the museum at the State Teachers College, Morehead, Kentucky; duplicate series of some species are also in the Museum of Zoology at the University of Michigan.[1]

Licking River arises in Magoffin County in the mountains of eastern Kentucky, flows northwestward and empties into the Ohio at Covington. Most of its tributaries are small creeks with sandstone or limestone bottoms interspersed occasionally with sand and mud. Collections were made from the main river and its tributaries in Rowan, Fleming, Morgan, Bath, Menifee, Montgomery, and Clark counties.

Early work in this region was conducted by Rafinesque (1819,1820) who reported nine species of fishes from Licking River. In 1888 Gilbert and Henshall made collections of 29 species in Licking River and Triplet Creek near Farmers. The results were published later by Woolman (1892). A summary of all the material on Licking River and other Kentucky and Tennessee streams was published by Evermann (1918).

A list of all species known to occur in the drainage follows. Whenever a species was taken by an earlier writer, his name, in parentheses, follows his locality record. All other records are by the writer.

1. *Ichthyomyzon bdellium* (Jordan): Ohio lamprey.—Taken in Licking at Farmers.

2. *Lampetra aepyptera* (Abbott): Ohio brook lamprey.—Taken in Licking at Farmers and Paragon; in Triplet at Morehead; in North Fork of Triplet at bridge over highway No. 32; in Yocum near its mouth; in Slate at bridge on U. S. 60 near Owingsville; in Christy three miles from its mouth. This species is known locally as mud eel and is used extensively as fish bait.

3. *Scaphirhynchus platorynchus* (Rafinesque): shovel-nosed sturgeon.—In former years this species was common in Licking near Farmers. It has not been taken for a number of years.

4. *Lepisosteus osseus* (Linnaeus): long-nosed gar.—Licking and Slate Creek (Rafinesque); taken in Licking and Triplet near Farmers and in Slate near Owingsville.

5. *Hiodon tergisus* Le Sueur: mooneye.—Licking and Triplet near Farmers. More common formerly than at present.

6. *Dorosoma cepedianum* (Le Sueur): gizzard shad.—Taken in large numbers in Gearhart Pond near Morehead, in Licking at Farmers, and in Triplet at mouth of Dry Creek. Apparently not common otherwise.

7. *Megastomatobus cyprinella* (Cuvier and Valenciennes.): big-mouthed buffalo.—Fairly common in Licking at Farmers. Numbers of rather large specimens are taken each spring during spawning season.

8. *Carpiodes carpio* (Rafinesque): river carp-sucker.—Taken in Licking at Farmers but not common.

9. *Carpiodes cyprinus* (Le Sueur): quillback.—Taken at Farmers in Licking.

10. *Catostomus commersonnii commersonnii* (Lacépède): common sucker.—Taken at Farmers in Licking and Triplet, in Cow near Salt Lick, in Big Stoner between Winchester and Mt. Sterling, and in Slate near Owingsville.

11. *Hypentelium nigricans* (Le Sueur): hog molly.—From Triplet (Woolman). This fish was taken more often than any other catostomid. Specimens were obtained from

[1] The writer is indebted to Milton B. Trautman of the University of Michigan for identification of many of the species and for criticism of the manuscript. The nomenclature used is that adopted by the University of Michigan. He wishes also to acknowledge the grant of a sum of money from the Kentucky Academy of Science to help finance the field work for this paper.

Triplet and Licking near Farmers, from North Fork of Triplet at several stations, from Christy near its mouth and near its source, from Slate at Owingsville, Fleming near Tipton, East Fork of Fleming near Sherburne, Big Stoner near Winchester, Yocum at Paragon.

12. *Erimyzon oblongus claviformis* (Girard): western creek chub-sucker.—Taken in Licking at Farmers but not common. Specimens were destroyed, but it is assumed that this was the species in question.

13. *Minytrema melanops* (Rafinesque): spotted sucker.—Taken in Yocum at Paragon, Fleming near Tipton, and Licking at Farmers.

14. *Moxostoma erythrurum* (Rafinesque): golden mullet.—This is the most common member of the genus. It is common in Triplet from Bluestone to the mouth. It was also taken in Slate at Owingsville, Licking at West Liberty and Farmers, East Fork of Fleming at Sherburne, Yocum and North Fork of Licking at Paragon, Fleming near Tipton.

15. *Moxostoma anisurum* (Rafinesque): white-nosed sucker.—Taken in Slate Creek at Owingsville. Not common.

16. *Nocomis micropogon* (Cope): river chub.—This is apparently the species reported by Woolman from Triplet and Licking as *Hybopsis kentuckiensis*. The writer has never taken this species, but Trautman has seen Licking River specimens.

17. *Extrarius aestivalis hyostomus* (Gilbert): northern long-nosed chub.—Licking, Triplet (Woolman). Taken in Licking near U.S. 60 bridge.

18. *Hybopsis amblops amblops* (Rafinesque): big-eyed chub.—Triplet (Woolman); common in Yocum and Christy; also taken in North Fork of Triplet.

19. *Semotilus atromaculatus atromaculatus* (Mitchill): northern creek chub.—Common. Taken in Christy, Yocum, North Fork of Triplet, North Fork of Licking, Cow, Slate and Fleming.

20. *Notropis volucellus buchanani* Meek: ghost shiner.—Taken in East Fork at Sherburne and Fox at crossing of U.S. 32. Intergrades between *buchanani* and *volucellus* have been taken in Fleming near Tipton. No typical *volucellus* have been obtained but they should occur in the drainage.

21. *Notropis deliciosus stramineus* (Cope): northern sand shiner.—Triplet (Woolman); East Fork, near Sherburne.

22. *Notropis boops* (Gilbert): big-eyed shiner.—Taken in Yocum, North Fork of Triplet, and Christy.

23. *Notropis spilopterus* (Cope): steel-colored shiner.—Taken in North Fork of Triplet, Slate at Owingsville, Licking at West Liberty, and Fleming near Tipton.

24. *Notropis whipplii* (Girard): satin-finned shiner.—Licking and Triplet (Woolman); obtained from Slate at Owingsville, Licking at West Liberty, and Fleming near Tipton.

25. *Notropis atherinoides dilectus* (Girard): southern emerald shiner.—Licking and Triplet (Woolman); Licking at West Liberty. Uncommon.

26. *Notropis photogenis* (Cope): silver shiner.—This is one of the commoner minnows of the drainage and was taken at all stations.

27. *Notropis rubellus* (Agassiz): rosy shiner.—Triplet as *dilectus* (Woolman); common in Yocum, North Fork of Licking, Christy, Triplet, and Fleming.

28. *Notropis cornutus chrysocephalus* (Rafinesque): southern common shiner.—Licking and Triplet as *N. megalops* (Woolman); common throughout the drainage, very abundant in Triplet.

29. *Notropis umbratilis cyanocephalus* (Copeland): northern red-finned shiner.—Taken in Slate at U.S. 60 bridge, and in Fleming near Tipton.

30. *Ericymba buccata* Cope: silver-jawed minnow.—Licking and Triplet (Woolman); taken in Yocum at Paragon, in Christy, in Triplet at Morehead, and North Fork of Triplet at Junction with Brushy.

31. *Phenacobius mirabilis* (Girard): sucker-mouthed minnow.—Taken in Cow Creek at crossing of U.S. 60 and in East Fork near Sherburne. Apparently it frequents the smallest streams of the drainage in the less mountainous section.

32. *Hyborhynchus notatus* (Rafinesque): blunt-nosed minnow.—Triplet and Licking (Woolman); very common in all parts of drainage; taken in Yocum, Upper Lick Fork, Slate, North Fork of Triplet, Triplet, Christy, Licking, Brushy, Fleming.

33. *Pimephales promelas promelas* Rafinesque: northern fat-headed minnow.—Taken Triplet and Licking near Farmers, from North Fork of Triplet at several stations, from in East Fork near Sherburne. Not at all common.

34. *Campostoma anomalum anomalum* (Rafinesque): Ohio tallow-mouthed minnow.—Triplet (Woolman); taken in Triplet, Yocum, Licking, Fleming, and Christy.

35. *Ictalurus furcatus* (Cuvier and Valenciennes): blue catfish.—Common in Licking at Farmers in the spring of the year.

36. *Ictalurus lacustris punctatus* (Rafinesque): southern channel catfish.—Triplet near Farmers (Woolman); common in Licking and mouth of Triplet.

37. *Ameiurus natalis natalis* (Le Sueur): northern yellow bullhead.—Not as common as other members of the genus. Specimens were taken from Fleming near Tipton and Licking at Farmers.

38. *Ameiurus melas melas* (Rafinesque): northern black bullhead.—A number of specimens were taken from Triplet near Clearfield.

39. *Ameiurus nebulosus nebulosus* (Le Sueur): northern brown bullhead.—Common in Triplet, Fleming, and Licking.

40. *Noturus flavus* Rafinesque: yellow stone catfish.—Triplet near Farmers (Woolman); taken in Licking at bridge on U.S. 60. Apparently uncommon.

41. *Schilbeodes miurus* (Jordan): brindled madtom.—Common throughout the drainage. This species was taken at all stations.

42. *Esox vermiculatus* Le Sueur: mud pickerel.—Licking (Woolman). Triplet at Morehead, Licking at U.S. 60 bridge, Fox at Ky. 32 bridge.

43. *Esox masquinongy ohiensis* Kirtland: Ohio muskallunge.—Taken in mouth of Triplet and in North Fork of Triplet near Ky. 32 bridge.

44. *Anguilla bostoniensis* (Le Sueur): American eel.—Licking River (Rafinesque). Eels have been taken in Licking near Farmers on several occasions but none of these specimens have been available for examination.

45. *Fundulus notatus* (Rafinesque): black-striped topminnow.—Not common. Taken in Triplet at Morehead; North Fork of Triplet at crossing of Ky. 32 and one-half mile upstream from this point; Fox Creek at crossing of Ky. 32.

46. *Percopsis omiscomaycus* (Walbaum): trout-perch.—A single large specimen was taken from North Fork of Triplet one mile upstream from the bridge on Ky. 32.

47. *Stizostedion vitreum* (Mitchill): yellow pike-perch.—Licking River (Rafinesque); reported from Licking by local fishermen at Farmers but no specimens were obtained for examination.

48. *Hadropterus maculatus* (Girard): black-sided darter.—North Fork of Licking at Paragon; North Fork of Triplet at bridge on Ky. 32; Cow Creek on U.S. 60; Slate Creek at U.S. 60 bridge; Fox at bridge on Ky. 32; Fleming near Tipton.

49. *Percina caprodes caprodes* (Rafinesque): log-perch.—Licking (Rafinesque); Triplet at mouth of Christy and at Morehead; Slate at U.S. 60 bridge; North Fork of Triplet at Ky. 32 bridge; Fleming near Tipton; Yocum at Paragon.

50. *Cottogaster copelandi* (Jordan): river darter.—A single specimen taken from Licking at West Liberty.

51. *Ammocrypta pellucida pellucida* (Baird): northern sand darter.—Licking at U.S. 60 bridge, at Paragon, and at West Liberty.

52. *Boleosoma nigrum nigrum* (Rafinesque): western Johnny darter.—Licking and Triplet (Woolman); common in Yocum at Paragon; Triplet throughout its length; North Fork of Triplet; Licking at Farmers and West Liberty; Slate at Owingsville.

53. *Poecilichthys variatus* (Kirtland): variegated darter.—Triplet Creek (Woolman). This species has not been taken during the present survey.

54. *Poecilichthys maculatus* (Kirtland): spotted darter.—Licking at Cynthiana (Henshall). This species was not taken during the present survey, but no collections were made in the vicinity of Cynthiana.

55. *Poecilichthys zonalis zonalis* Cope: northern darter.—Licking and Triplet (Woolman); common at all stations, probably the commonest darter in the drainage.

56. *Poecilichthys caeruleus* (Storer): rainbow darter.—Triplet (Woolman); Licking at Cynthiana (Henshall); Yocum, Triplet, North Fork of Triplet and Fleming.

57. *Catonotus flabellaris flabellaris* (Rafinesque): barred fan-tailed darter.—Licking and Triplet (Woolman); Cynthiana (Henshall); Yocum at Paragon; Triplet at More-

head; North Fork of Triplet at junction with Brushy. Not very common.

58. *Etheostoma blennioides blennioides* (Rafinesque): northern green-sided darter.—Cynthiana (Henshall); Salt Lick Creek at Salt Lick; Licking at U. S. 60 bridge; North Fork of Triplet at Ky. 32 bridge.

59. *Micropterus pseudaplites* Hubbs: spotted bass.—Common in Triplet and Licking at Farmers.

60. *Micropterus dolomieu* Lacépède: small-mouthed bass.—Triplet (Woolman); Licking (Rafinesque); more plentiful than the large-mouthed. Taken in Triplet, Licking, Yocum, North Fork of Triplet, and Fleming.

61. *Huro salmoides* (Lacépède): large-mouthed bass.—Triplet (Woolman); common in Yocum, Beaver, Slate, Triplet, Licking and Fleming. This species is exceptionally abundant in Fleming near Tipton.

62. *Apomotis cyanellus* (Rafinesque): green sunfish.—Licking (Rafinesque); Triplet (Woolman); taken in Yocum, North Fork of Triplet, Triplet, Cow, Licking, and Fleming. Very common.

63. *Helioperca macrochira* (Rafinesque): bluegill.—Licking (Rafinesque); Triplet as *pallidus* (Woolman); Licking; Lewis pond near Farmers; Triplet near Farmers.

64. *Xenotis megalotis megalotis* (Rafinesque): southern long-eared sunfish.—Licking (Rafinesque); Triplet (Woolman); Yocum, Triplet, North Fork of Triplet, Cow, Slate, and Fleming. This species is extremely abundant in Fleming near Tipton. Many large specimens were taken.

65. *Ambloplites rupestris* (Rafinesque): northern rock bass.—Licking (Rafinesque); common in Triplet, Licking, Slate, Fox, and Fleming.

66. *Pomoxis annularis* Rafinesque: white crappie.—Lewis pond near Farmers: Licking at Farmers; North Fork of Triplet near Ky. 32 bridge; Slate near Owingsville.

67. *Labidesthes sicculus sicculus* (Cope): northern brook silverside.—Common throughout the drainage in still water. Taken from Yocum, Christy, Triplet, North Fork of Triplet, Fox, Fleming, Slate, and Licking.

68. *Aplodinotus grunniens* Rafinesque: sheepshead.—North Fork of Triplet near mouth of Brushy; Licking at Farmers, and at West Liberty.

69. *Cottus bairdii bairdii* Girard: northern muddler.—Two specimens were obtained from Triplet at the bridge on Christy Creek road.

Addendum.—Since this manuscript was prepared, the following has been taken:

70. *Chrosomus erythrogaster* Rafinesque: southern red-bellied dace.—Fox Creek at bridge on Ky. 32.

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Notes on Invasion of Fresh Water by Fishes of the Gulf of Mexico, with Special Reference to the Mississippi-Atchafalaya River System

By Gordon Gunter

In addition to anadromous fishes that run up rivers to spawn, other marine fishes, as well as crustaceans and molluscs, have long been known to enter fresh water, especially in the tropics. The phenomenon is not unknown in this country, although published records are rare. For that reason the writer has brought together here some information on the subject. Some of this is not based on actual data, but on reports that are considered to be reliable. These are given not as an attempt to establish a record, but for the purpose of calling the matter to the attention of workers who might add to knowledge of the subject by observations over a wide front.

In the summer of 1936 my attention was called to reports that sharks, stingarees, "little flounders," mullet and tarpon are occasionally caught during the spring and summer in the Atchafalaya River at Simmesport, Louisiana, which is over 160 miles, as the river runs, from the Gulf of Mexico. On August 3, 1937, the writer examined a shark in the ice plant of the Simmesport Fish Company, which had been taken on a gar line immediately below the Simmesport bridge two weeks previously. It weighed approximately 55 pounds and was identified as the Gulf shark, *Carcharinus platyodon* (Poey). On August 12, 1937, a shark was caught on a gar line in Red River near its mouth. From this point to the Gulf via the Atchafalaya the distance is over 190 miles, while by way of the Mississippi it is 316 miles. The shark, which I did not see, weighed 255 pounds on the cotton gin scales at Moreauville, Louisiana.

Also in the ice plant was a specimen of the common stingaree, *Dasyatis sabina* (Le Sueur), which was reported to have been caught in a hoop-net, during the summer of 1936, in the Mississippi River above Angola, Louisiana. The shortest route the fish could have used in ascending (by the Atchafalaya) would make the distance traveled from the sea somewhat over 200 miles. On August 31, 1937, there was an account in the New Orleans Times-Picayune of the capture of a stingaree in the river at New Orleans. The river stage was 2.6 feet and United States Weather Bureau officials stated it was unlikely that the salt water could reach the city from the Gulf of Mexico. Hildebrand and Schroeder (1927) recorded this species from the lower York River of the Chesapeake Bay region.

Tarpon are commonly known to enter fresh water at river mouths. Gowanloch (1933) has presented observations of Louis L. Babcock indicating that the fish will live indefinitely in that medium. Hildebrand (1937) has given detailed information on their presence in the Panama Canal Zone. It was assumed by Dr. Meek that tarpon in Lake Nicaragua were landlocked (Hildebrand, *op. cit.*). Fishermen of the Simmesport area state that they have seen tarpon and sharks caught by gigs in the Black River near Jones-

ville, Louisiana, which is over 270 miles from the Gulf by water. So far as could be ascertained no tarpon were taken at Simmesport during the last summer, and I have seen no specimens there.

A "little flounder" was caught in a dip-net in the river at Simmesport by a fisherman on August 12, 1937. It proved to be the common American sole, *Trinectes maculatus* (Bloch and Schneider), a young specimen measuring only 2.3 inches in total length. Rafinesque probably first recorded this fish from fresh water, saying that it came from the Schuylkill River (Chabanaud, 1930). Breder (1929) says the species may invade fresh water, especially when young, and Hildebrand (in press) records it from the Savannah River at Augusta, Georgia, that being a deeper inland invasion than reported here from the Atchafalaya River by about forty miles. He also records the fish about 100 miles upstream in the Pascagoula River of Mississippi.

The soles are said by fishermen to be sometimes taken in bait seines from pits on the bank of the Atchafalaya. The pits, formed by digging dirt for the levees, were twenty feet above the river level in August, 1937, and any fish in them had evidently been stranded when high water went down in the spring. Although I was unsuccessful in attempts to collect soles from these localities, I am inclined to believe nevertheless, in the statements of the fishermen, who are well acquainted with all of the larger aquatic animals of their vicinity. The pits were from three to four feet deep and contained water plants. Other fishes living in them were the white perch, *Pomoxis annularis* Rafinesque, and the shad, *Dorosoma cepedianum* (Le Sueur).

The writer is indebted to Dr. C. M. Breder, Jr. of the New York Aquarium, for the information that young specimens of the American sole are often on sale for fresh water home aquaria in New York City, and to Dr. S. F. Hildebrand, of the Bureau of Fisheries, for information that small specimens have been kept for about two years in the Bureau of Fisheries Aquarium at Washington. Presumably, then, the fish can live indefinitely in fresh water.

The migration of mullet into the inland waters of the United States south Atlantic coast has been a matter of common knowledge for many years. Ravenel (1889) stated that among the objects of his investigation of the mullet fisheries of South Carolina and Florida (species unstated) was inquiry "as to seasons of migration from salt to brackish or fresh water and their return" and "spawning places—whether in salt, brackish, or fresh water." The depth and extent of this migration has received little attention. Schools of mullet are known to come up the Atchafalaya River in the spring as far as Avoyelles Parish, where they spread out into bayous and canals. As stated above, this migration is about 160 miles from the sea.

On October 3, 1937, the writer saw mullet, *Mugil cephalus* Linnaeus, weighing 4.5 pounds taken by seining in rice canals near Palacios, Texas. They were in the company of the large-mouthed black bass, the buffalo, *Ictiobus urus* (Agassiz), the fresh water catfish, *Ictalurus furcatus* (Cuvier and Valenciennes) and the white perch, *Pomoxis annularis*. The fish had entered the canals from the Colorado River. Mr. J. G. Burr of the Texas Game, Fish and Oyster Commission has given information that mullet (species unstated) are caught in the Colorado River at Austin. The distance from Austin

to Matagorda Bay by way of the river is 274 miles. Hildebrand (1925) took specimens of *M. cephalus* from Rio Lempa, El Salvador, about 180 kilometers from the Pacific Ocean and Dr. R. E. Coker (Evermann and Radcliffe, 1917) has taken the fish from the fresh water streams of Peru.

According to Ravenel (*op. cit.*) roe mullet are taken coming out of fresh water and all indications are that spawning does not occur there, though the spawning place of mullet is not yet definitely known.

The gizzard shad, *Dorosoma cepedianum* Le Sueur, is present in brackish waters along the Atlantic and Gulf coasts and throughout the Mississippi Valley. According to Coker (1929) the fish is present all the year near Keokuk, Iowa. He states that no necessity for extensive migrations of the gizzard shad is known. However, such migrations do take place. In the spring large schools of this species, coming evidently from brackish water on the coast, pass up the Mississippi River at New Orleans in such numbers that they may be caught by dipping blindly with dip-nets in the turbid water. Since it is not the habit of this fish to spawn in salt water, that part of the population living there must enter fresh water to spawn, so that part of the population at least is anadromous.

A discussion of the theoretical aspects of migrations of animals from the sea to fresh water is not necessary here, but certain facts are pertinent and are mentioned without reference to the many authors from which they are derived. Those interested in a discussion of the theory should refer to Pearse (1936).

Marine animals entering fresh water must be able to overcome increased difficulty in breathing, prevent the loss of essential body salts and prevent undue osmotic swelling. Breathing is easier in the sea, owing in part to the presence of salts that take up carbon dioxide. Fresh water animals also have greater oxygen requirements, probably because they expend more energy in maintaining osmotic equilibrium. Ringer (1883) found that calcium salts would sustain the life of fishes longer than would those of sodium and potassium. Later workers have shown that calcium helps respiration by maintaining the alkali reserve of the blood. Possibly the rivers mentioned here carry relatively large amounts of calcium salts. The problem is in need of study, for apparently there are few data on the chemical contents of most rivers.

The tarpon is an active fish and must consume comparatively large amounts of oxygen. The swim bladder contains lung tissue (Hildebrand, 1937) which probably is of assistance in overcoming the increased difficulty in breathing when the fish moves into fresh water. The well known leaping habit of the tarpon may be for the purpose of getting air.

The sluggish rays and soles may partly offset the increased difficulty in breathing in fresh water by being able to live on less (available) oxygen than is ordinarily present in their marine habitat.

The Atchafalaya River is second in size to the Mississippi in Louisiana, and during floods has discharged over 500,000 cubic feet per second. It is fed chiefly by the Red River and the Mississippi, and runs roughly parallel to the latter from its origin near the confluence of the two. It has increased greatly in size in the last hundred years, apparently as a result of the growth

of the levee system. Rivers carry greater amounts of salts at their lower reaches than at the headwaters, but there is no reason to expect that the Atchafalaya is any more or less fresh than other rivers. I am informed by Lieutenant Colonel William F. Tompkins of the U. S. Engineer Office that it is impossible for Gulf water to come up the Atchafalaya River as far as Simmesport at any time. Although the river has a strong current, which may exceed eight miles per hour during flood, two such unstreamlined forms as the stingaree and broad sole, as well as the even less powerful swimmer, the blue crab,[1] are able to overcome it.

One inference to be drawn from the knowledge of occasional or seasonal invasions of fresh water by marine species, is that the discovery of fossils in fresh water deposits does not mean necessarily that the species was a fresh water fish or originated in fresh water.

The writer is indebted to Messrs. Allen Coco and Oliver Lacour for aid in gathering specimens, and to Mr. Russell C. Bennet, U. S. Engineer Office, Galveston, Texas, for information on river distances.

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[1] A record of the portunid crab, *Callinectes sapidus* Rathbun, has been given in this locality (Gunter, 1938).

A Note on the Origin of Solenoglyph Snakes[1]

By GEORG HAAS[2]

THE PRIMITIVE and isolated position of the genus *Causus* in the family Viperidae is well known. It is shown by the primitive arrangement of the head shields and the incomplete development of the movable jaw-apparatus, with the skull not shortened to the degree of the normal viperid type.

The first investigators of the anatomy of these snakes were interested primarily in the extraordinarily elongate poison glands. Phisalix seems to have been the first to extend the investigation to the characteristic muscle apparatus in the region of the poison gland. I recently criticized Phisalix' attempt to associate the proteroglyph with the solenoglyph groups (Haas, 1931 b).

Thanks to the friendly interest of Professor Franz Werner, of Vienna, I have been able to examine a specimen of *Causus resimus* and compare its cephalic anatomy with that of *Causus rhombeatus*. It is to be desired that the remaining two species *C. defilippi and C. lichtensteini* be examined also, but these have not been available.

Causus resimus has the same enormously elongated poison glands as *C. rhombeatus*. There are considerable differences in the musculature associated with the glands, however, which bear upon the direction of evolutionary differentiation toward the rather uniform solenoglyph type. These differences are found in the distribution of the anterior jaw-muscles, which afford characteristic differential characters in other groups of snakes also.

These characters are as follows:

1. The deep division of the M. adductor externus superficialis,[3] which was overlooked by Phisalix and others, arises directly behind the origin of the arched superficial division of this muscle in *resimus*. The Harderian gland extending backward from the orbit is relatively somewhat smaller than in *rhombeatus*, and consequently modifies the adjacent musculature less. In *rhombeatus* the deep division of the superficialis originates just in front of the dorsal head of the quadrate, while in *resimus* it arises in more primitive fashion from the beginning of the lateral temporal insertion ridge.

2. This muscle, functioning as a levator anguli oris, surrounds the angle of the mouth more completely in *resimus*. Its insertion below the inner angle of the mouth and sublabial gland extends forward to about the level of the posterior border of the eye (diagrammed in fig. 5).

3. The M. adductor externus medialis arises in the primitive way from the posterior half of the temporal ridge instead of from the upper end of the quadrate. Thus only the adductor externus profundus takes origin from the quadrate.

4. The relations between the adductor externus medialis and the poison

[1] Contribution from the Zoological Institute of the Hebrew University, Jerusalem.
[2] Translated by Karl P. Schmidt and D. Dwight Davis.
[3] As in my previous papers on the musculature of the head in snakes, the terminology used by Lakjer has been employed.

gland are different from those jn *Causus rhombeatus,* although conditions are probably also variable within *resimus* (as they were in *rhombeatus,* Haas, 1931 b). As in my first specimen of *rhombeatus,* there is no dorsal muscle band. The gland muscle comes from a ventral bundle only, which from a point at the anterior border of the profundus on bends sharply posteriorly around the anterior edge of the profundus, dividing into dorsal and ventral bundles on the inner face of the gland. In this way the muscle complex surrounding the gland has a single origin. The neck of the gland is furthermore fixed by aponeuroses; one extends anteriorly from the medialis and posteriorly on the profundus. A short aponeurosis also leaves the muscle opposite the ventral edge of the neck of the gland. In the profundus region muscle fibers radiate into these aponeuroses both dorsad and ventrad, but do not extent to the gland. Because of the dorsal connection of the gland-muscle with the medialis in *rhombeatus,* I placed the whole muscle with this part of the adductor system. In this species the ventral part of the gland-muscle arises exactly from the meeting place of the medialis and profundus. Only this ventral part is present in *resimus,* but it is more medial in position and more closely connected with the profundus than with the medialis. With a reservation as to a final opinion on the genesis of the gland-muscle, I still regard a derivation from the medialis as the more probable.

5. The superficial part of the M. adductor externus superficialis inserts almost entirely on the lower jaw, and not partly on the anterior edge of the profundus as it does in the somewhat more slender *rhombeatus.*

6. The M. adductor externus profundus differs only in minor details from that of *rhombeatus.* Its structure is primitive; it is not pinnate, and insertion is effected by an extensive aponeurosis.

7. The depressor mandibulae is distinctly divided into two parts, which originate on either side of the quadrate.

Two principal conclusions may be drawn from this list of the chief differences between *Causus resimus* and *C. rhombeatus* in this part of their head musculature. *C. resimus* is the more primitive, especially in the origin of the adductor externus medialis from the temporal ridge, and the associated disposition of the deep division of the adductor externus superficialis and the adductor externus profundus. Secondly, it appears that the individual parts of muscles and their subdivisions are relatively constant structures, which may be displaced in various ways in the temporal region without losing their identity.

In this connection I wish to criticize a statement of Radowanowitsch (1935:390) that "As all the temporal muscles on the snake head undoubtedly are genetically very close and must all be derived from a single *primary muscle* (italics mine), it is not always easy to delimit the individual parts and determine their relation to particular muscles, as these are often in turn subject to further subdivision." No recent vertebrate, and in particular squamate, with a "primary muscle" of this nature is known to me. The lizards, which most closely represent the ancestry of the snakes, have the most complicated temporal musculature imaginable—as do the primitive snakes, with the exception of the pythons and boas. The presence of the temporal arch and its secondary loss are unmistakable marks of a process of reduction in the

musculature, which is still to be found in some of its last stages. I have endeavored to show, in my papers on the jaw musculature of snakes, the gradual simplification of the head musculature in correlation with the development of the typical snake skeleton. In the course of this reduction the individuality of each muscle is retained, to a sufficient degree to make possible an attempt to homologize the muscles with those of lizards (Lakjer, Haas).

On account of the undoubtedly slow transformation in the temporal muscles, the *Causus* material affords important links for understanding the trend of differentiation which leads to the viperid type. The fully developed viperid and crotalid arrangement (as in *Trimeresurus* and *Bitis*) is shown in fig. 7. The gland compressor (the superficial division of M. adductor externus superficialis) arises on the upper surface of the poison gland, encloses it posteriorly, and arches forward to insert on the lower jaw. The deep division of the superficialis arises at the anterior end of the temporal ridge. It runs beneath the superficial division and the gland and emerges below the gland external to the superficial division, thus crossing over the lower half of the superficial layer. It then inserts aponeurotically external to the latter. This crossing of the muscles is characteristic of all viperids, and with certain reservations of *Causus*, also. In certain viperids the deep division of the superficialis is greatly reduced, and may even disappear, as in *Vipera russellii* and *Atractaspis*.

The hypertrophy of the poison gland in *Causus*, by shifting the gland from the temporal region, results in the retention of the ancestral condition of the muscles as they were before the development of the muscular coat surrounding the gland, which otherwise is an invariable characteristic of the solenoglyph type.

This assertion may appear paradoxical, since *Causus* also has a poison gland muscle, but it can be well substantiated. The glands of *Causus* develop by simple elongation of the sacs. This elongation appears to continue throughout the life of the snake, as a definite proportional relation between the length of the snake and of its glands can be demonstrated. In very young specimens the gland extends only a little beyond the posterior border of the skull. Its unusually increased and accelerated longitudinal growth obviously prevents normal development of the anterior temporal muscle, which tends at a particular stage to embrace the posterior end of the gland. The delayed stimulus to the jaw musculature thus affects muscles more posterior in position, which produce the gland compressor consequently in quite a different way. The variability of this connection indicates that the hypertrophy of the gland is a relatively recent acquisition and without phyletic significance. Since the attachments of the superficial division of the adductor externus superficialis are in front of the gland, the position of this muscle has not been modified by the gland. It may therefore be assumed to lie in the position characteristic of the ancestral forms which, like the aglyph and opisthoglyph snakes, had no gland compressor, even when a poison gland or an equivalent structure was present.

The anterior position of the deep division of the superficialis in *resimus* affords an example of a much more primitive viperid type of crossing of the

muscles than in *rhombeatus*. The superficial division of the superficialis, which has the form of a semicircle of muscle, differs from the typical solenoglyph condition in not having any connection with the poison gland. It arises from the anterior part of the temporal ridge and from the postorbital bar, instead of from the dorsal surface of the gland.

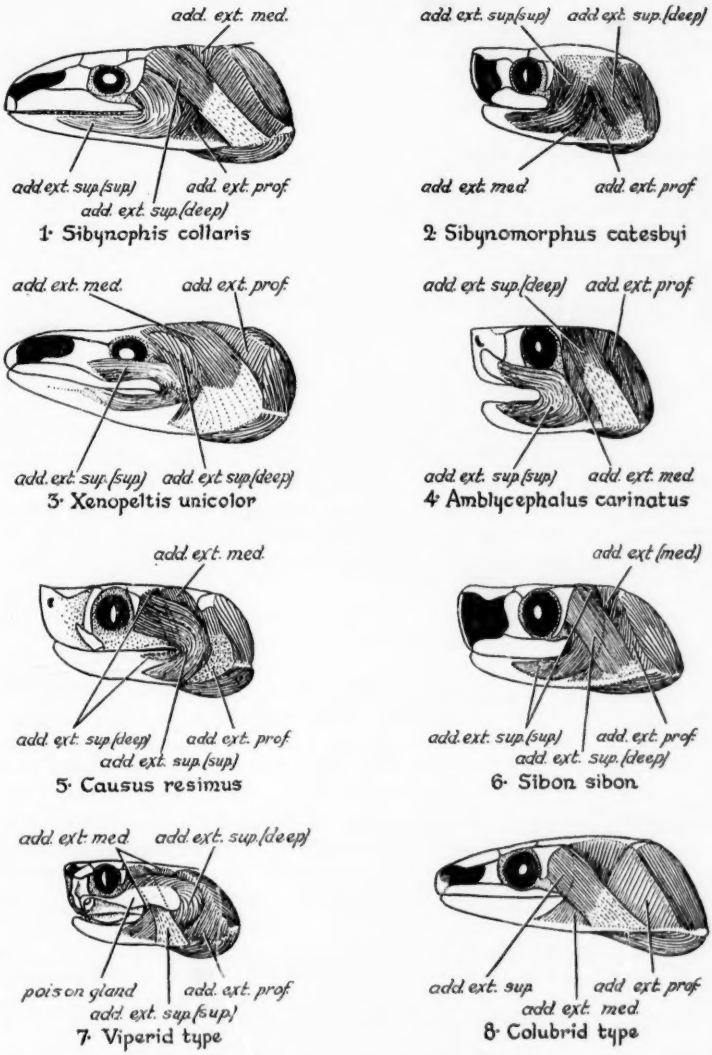
Something like this position is shown by Phisalix' figure of *Vipera aspis* and according to Radowanowitsch the ventral parts of the deep division of the superficialis are more anterior in position than *Cerastes*. Radowanowitsch further reports that *Bitis* has two muscles in the place occupied normally by the single deep division of the superficialis, and thinks it possible that the accessory element might be a part of the medialis which has moved forward. Except for *Vipera russelli* and *Atractaspis*, the solenoglyph type is otherwise extremely stable. A moderate peculiarity of the extremely broad and short-headed *Bitis* is no more than would be expected.

The protero-solenoglyph stage exhibited by *Causus* consequently shows a relatively short-headed form in which the superficial division of the superficialis is not connected with the poison gland. Instead it arches around the angle of the mouth, extending from the postorbital bar and adjacent parts of the temporal ridge to the angulare. The deep division of this muscle extends mesad from the superficial division obliquely toward the angle of the mouth, to insert on the lower jaw (fig. 5).

Essentially the same partition of the superficialis is found in *Xenopeltis* (fig. 3), *Sibynophis* (fig. 1), *Amblycephalus* (fig. 4), and *Sibynomorphus* (fig. 2), but with successively placed origins in accordance with the elongate temporal region in the skulls of the first two. The origin of the superficial part of the superficialis may be displaced ventrad in this type, sometimes even to a completely preorbital position on the maxillary (fig. 3, 4). The deep division of the superficialis ends aponeuretically, extending obliquely backward to the mandible. Primitive forms of this type may evolve in two alternate directions when the temporal region is greatly shortened. As one alternative, the origin of the deep division of the superficialis, which becomes tendinous about at the level of the quadrato-maxillary ligament, is displaced laterad or mesad of the origin of the superficial division. This is the type represented by *Sibynomorphus* (fig. 6), in which the mesad superficial division is shortened at its insertion, and ends on the inner rictal plate[4] instead of on the lower jaw. The second alternative leads to the viperid type, in which the origin of the deep division is displaced mesad and ends farther forward on the angle of the mouth, instead of aponeurotically on the posterior end of the lower jaw. In effect, this is the condition in *Causus* (fig. 5).

The true viperid type is explained by the extension of the deep division of the superficialis from the angle of the mouth posteriorly beneath the poison gland, after the development of a slight crossing of the fibers on its underside. This leads to a change of function, the original effect on the sublabial gland being transformed to that of inner compressor of the poison gland. The muscle arrangement common to the Boidae, Colubridae, and Boigidae may be

[4] This term (from "rictus"=angle of the mouth) is used to designate the large connective tissue plates inside the last upper or lower labial scutes which provide points of insertion for muscles in many snakes. It is more appropriate than the awkward German term "Mundplatte" originally applied by Lakjer (1926). [Translators.]



Diagrams of head musculature in a series of snakes.

Add. ext. med., M. adductor externus medialis; *add. ext. prof.*, M. adductor externus profundus; *add. ext. sup.* (*deep*), M. adductor externus superficialis, deep layer; *add. ext. sup.* (*sup.*), M. adductor externus superficialis, superficial layer.

understood from the condition in *Sibynophis* by the omission of the superficial division of the superficialis (fig. 8). I have attempted to explain the uniform and characteristic proteroglyph type as developed from this simple boid and colubrid type elsewhere (Haas, 1930 b).

The mode of development of the viperid type here set forth agrees rather with phylogenetic conclusions drawn by Mosauer from the trunk musculature of the Serpentes than with the more current views, which derive the viperids either from the proteroglyphs or from opisthoglyphs. I agree with Mosauer that the highly specialized solenoglyph type must be derived from extremely primitive colubrids. A few types of primitive aglyph colubrids have retained the primitive musculature from which the viperid condition is derivable, even when the body musculature has diverged independently in the two groups.

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The Breeding Habits of *Pseudacris brachyphona* (Cope) with a Description of the Eggs and Tadpole

By N. Bayard Green

THE mountain chorus frog, *Pseudacris brachyphona,* was first described by Cope in 1889 as a variety of *Chorophilus feriarum.* No further attention was paid to it until 1932 when Walker (1932: 379) removed it from its obscure position and established it as a valid species. Netting (1933: 4) records it from five counties in West Virginia; Walker (1932: 381) gives the measurements of three West Virginia specimens from the Carnegie Museum; Wright and Wright (1933: 84) record it from the extreme southern part of West Virginia.

Despite the fact that *Pseudacris brachyphona* is fairly common throughout the central and southern part of West Virginia, where it has been collected between altitudes of 1200 feet and 3500 feet, little seems to be known about its life history and breeding habits. Walker (1932: 383) gives a brief description of the eggs and of the situations in which they are laid. Wright and Wright (1933: 85) state that the tadpole has not been described, and that there are no data on transformation. During the spring months of 1936 and 1937 the author had an opportunity to observe the breeding habits of this frog as well as to collect the eggs and tadpoles at various stages. Most of the observations were made in the vicinity of Elkins, Randolph County, and in Tucker County, lying to the east of Randolph; other specimens were collected and notes were taken in Barbour, Upshur, Braxton and Pocahontas counties, all in West Virginia. The preserved material on which the paper is based is in the author's private collection.

In central West Virginia *Pseudacris brachyphona* begins calling about the first of April. It is the third frog voice to be heard in the spring in Randolph County. *Hyla crucifer* and *Rana sylvatica* have been calling for two to four weeks before it emerges. The males appear two to four days before the females and congregate in temporary pools and drainage ditches from which they call lustily. They line the edges of the pools, stationing themselves either in or out of the water. Most of the males collected were in the water with their backs to the edge of the pool. Those taken from the bank were facing the pool and a short distance from it. They collected on mats of algae or other vegetation or floated with legs outstretched. They showed a decided preference for shallow and slow-moving or quiet bodies of water and no specimens were seen near permanent bodies of water. On one occasion several individuals were found calling from water-filled furrows of a freshly ploughed field.

They make no effort to conceal themselves in the stubble or rubbish around the pools as does *Hyla crucifer.* Frequently there were fifteen or twenty males around the edge of a pool five feet in diameter. Along ditches there were often three or four males every two feet. The males were more plentiful than the females; the ratio of sexes seen and collected was about six to one.

Their notes are repeated at the rate of about 50 to 70 times a minute and

may be continued for several minutes although they usually stop in fifteen to twenty seconds. The call is strong and rapid and on a clear night a chorus may carry for a quarter of a mile. Walker (1932: 383), comparing the call with that of *Pseudacris n. triseriata,* says, "The voices of the two are much alike but the call of *brachyphona* is given more quickly, with a higher pitch and a different quality so that the effect of a chorus is quite distinctive." Toward the last of the breeding season, when the males were calling irregularly, the passing of a motor car along the road would cause them to start their song. As the car passed on they would cease, only to commence again as another car approached. Probably the vibration of the car stimulated calling.

Although most of the observations were made at night, several trips during the day found the frogs as active as at night. Males were found calling throughout the afternoon. Breeding pairs were also collected and observations made of females laying eggs at this time.

The females arrive at the breeding site shortly after the males. In one instance they were observed crossing a concrete road in order to get to a field from which the males were calling. Males did not seem to be aware of a female's presence until their bodies touched. In the laboratory males were seen to grasp spent females. They did not release the female at once. On several occasions males would grasp other males only to release them when the clasped male struggled to free himself. Further observations and experimentation are necessary to determine the basis for sex recognition in this species.

Amplexus is axillary, with the small male tightly grasping the armpit region of the larger female. While in amplexus the female is usually partly submerged with legs outstretched. On one occasion a clasping pair was taken from under water.

Egg masses were found in the region under observation (Randolph and Tucker counties, West Virginia, at an elevation of 2,000 feet) on April 5. Walker (1932) states that fresh eggs have been found as early as March 20, presumably in southern Ohio. Pairs in amplexus and eggs were taken at Porterwood, Tucker County, on June 10, 1936, at an elevation of 2,200 feet and on Point Mt., Randolph County, on June 7, 1937, at an elevation of 3,500 feet following a rainy spell of several days. Freshly laid eggs were collected by C. J. Goin at Camp Woodbine, Nicholas County, on July 2, 1936, at an elevation of 2,000 feet. His notes for this date read, "Small pool visited at dusk following a rain. A long dry spell had preceeded this rain. One clutch of freshly deposited eggs was observed."

The eggs are laid in masses of from ten to fifty eggs, most masses containing about twenty-five eggs. The mass is soft and slips easily through the fingers. The eggs are attached to vegetation or trash, usually partially submerged grass, leaves or sticks. The anchorage seemed to be the petioles, margins and apices of dead leaves. No masses were found floating and there were none on the bottom of the pools.

On April 13, 1937, five females were collected on their way to the pools. In the laboratory each female was put in a separate jar with a male in an effort to determine the number of eggs an individual laid. They laid respectively 1,479, 383, 318 and 406 eggs. One female laid no eggs although

clasped by the male at intervals for more than a week. Her body, when opened, contained many eggs.

Each egg is inclosed in an envelope, the total diameter varying from 6.0–8.5 mm., the average 7 mm. Owing to the soft envelope and its adherence to the adjacent ones it is difficult to measure individual eggs. The vitellus measures 1.6 mm. The vegetal pole occupies from one-third to more than half of the egg and is a creamy white color. The mass of each egg is approximately .26 cc., as 116 eggs occupied 30 cc.

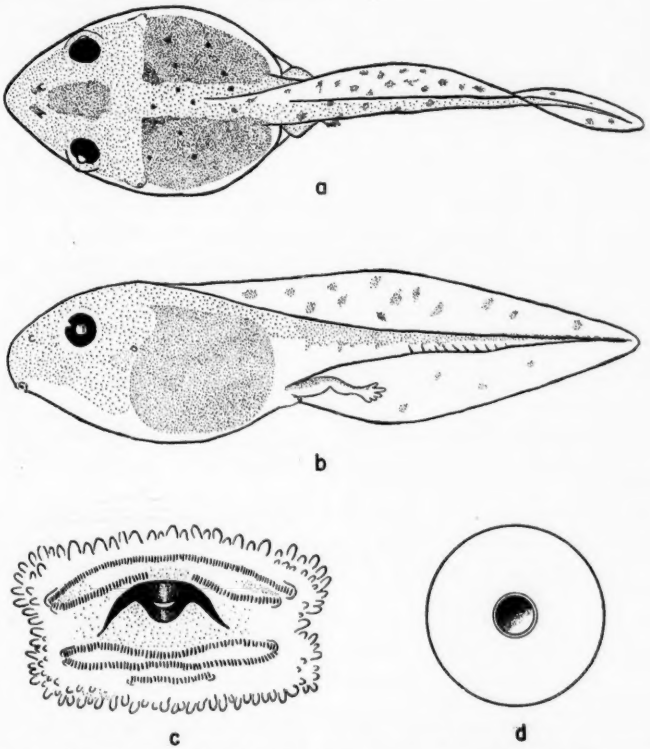

Fig. 1. Tadpole of *Pseudacris brachyphona:* a. Dorsal view of a 25 mm. specimen; b. Lateral view of same; c. Mouth parts of same (x 25); d. Egg (x 4).

Hatching occurs about the 110th hour after laying at room temperature. At the time of hatching the larvae measure 4.5 to 5.0 mm. By the 133rd hour they have increased to 6 mm. The period of transformation covers about two months. One temporary drainage ditch near St. George, Tucker County, at an elevation of 2,300 feet, was carefully observed and tadpoles taken each week. The tadpoles in the laboratory were kept in fingerbowls and fed algae. Their development was slower, their size smaller, and their color darker than the specimens in the field. The first transformed individuals were taken from

the ditch on June 10. The measurements of a newly transformed individual are as follows (in mm.):

Length of body	8.0	Depth of head	2.1
Length of head	2.2	Length of femur	3.0
Width of head	3.0	Length of tibia	2.7

At this stage the dorsal pattern is plainly visible, especially the interorbital triangle.

DESCRIPTION OF TADPOLE.—Tadpole small, full and deep bodied. Maximum size before metamorphosis 25 mm.; tail tip obtuse, rounded; dorsal crest full, extended to middle of body; eye slightly dorsal to lateral axis; spiracle not prominent, sinistral, directed backward and upward. Body black-brown above, brown predominant; under hand lens black with many clusters of tiny gold dots. Under parts bronzy black; black along side. Scattered pigment dots in dorsal crest of tail. Small amount of pigment in lower edge of musculature of tail, as is true of ventral crest. Body transparent. Mouth-parts.—Labial teeeth 2/3. Upper labium fringed with a continuous row of labial teeth. The median space between the second lateral upper labial rows short, about $\frac{1}{4}$ the length of either row. Third lower labial row about $\frac{1}{2}$ the width of the second. The horny beak about $\frac{1}{2}$ the width of the upper row of teeth. The hind legs bud when the tadpole reaches a length of 19 mm.

Measurements of the largest tadpole (in mm):

Total length	25.0	Spiracle to snout	6.0
Body length	10.5	Spiracle to vent	5.0
Body depth	6.0	Eye to snout	3.1
Body width	7.0	Eye to nostril	1.7
Tail length	14.5	Nostril to snout	1.6
Tail depth	5.8	Mouth	2.0
Musculature of tail	2.0	Interorbital	2.8
Internasal	1.0		

SUMMARY.—*Pseudacris brachyphona* is fairly common throughout central and southern West Virginia. The breeding season is an extended one, lasting from the middle of March into July. The females lay 300-1500 eggs which are in soft masses and are attached to trash in the water. They hatch in four to five days. The period of transformation covers 50–60 days and the tadpole reaches a maximum size of 25 mm.

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The Jamaican *Dromicus funereus* (Cope) Re-established

By Chapman Grant

THE colubrid genus *Dromicus* is represented by two small species on Jamaica. Gosse described *D. callilaemus* in 1851 and it seems possible that he also saw specimens of the second species, but did not recognize them as distinct. Cope described the second species, *D. funereus*, in 1862, but it has not been referred to since except for Boulenger's reference to synonymy in 1894, and Barbour's allusion to it in 1910 as a black phase of *L. callilaemus*. The differences lie in the great color contrast; size of loreal; proportions; and habits. The species may be distinguished as follows:

Reddish, caudals more than 100 (104–120) ..... *callilaemus*
Blackish, caudals less than 100 (70–91) ..... *funereus*

Dromicus callilaemus (Gosse)

Natrix callilaema Gosse, Nat. Sojourn in Jamaica, 1851: 384; Hallowell, Proc. Acad. Nat. Sci. Phila., 1856: 237.

Dromicus callilaema, Günther, Cat. Snakes Brit. Mus., 1858: 131; Ann. Mag. Nat. Hist., (3) 12, 1863: 357.

Liophis callilaemus, Boulenger, Cat. Snakes Brit. Mus., 2, 1894: 142–143.

Leimadophis callilaemus, Barbour, Bull. Mus. Comp. Zool., 52, 1910: 300; Mem. Mus. Comp. Zool., 44, 1914: 338; Handbook of Jamaica, 1922: 669; Orcutt, Jamaican Nat., 1, 1928: 7–8.

Dromicus callilaemus, Cope, Proc. Acad. Nat. Sci. Phila., 1862: 76; Reinhardt and Lütken, Vid. Med., 1862: 162; Barbour, Zoologica, 11, 1930: 113; *idem*, 19, 1935: 138; Dunn, Copeia, 1932: 89–90.

Type.—Unknown.

Description.—Adult male, writer's collection, No. 420. Rostral broader than high, scarcely visible from above; internasal suture slightly shorter than prefrontal suture; frontal about equal to its distance from end of snout, shorter than parietals, separated from the preocular; supraocular narrower than frontal; nasal divided, longer than its distance from eye; loreal small, quadrangular; one large preocular; two postoculars; one large anterior temporal followed by two smaller ones; seven supralabials, second in contact with posterior nasal, loreal and preocular; third and fourth supralabials entering eye; eight lower labials, four in contact with anterior chin-shield, two in contact with posterior; anterior chin-shields shorter than the posterior; scales smooth, without pits, in 19 rows; ventrals 139; anal divided; 115 pairs of caudals.

Variation.—The loreal is smaller and tends to be more quadrangular in this species than in *funereus*. The scale rows reduce from 19 to 17 or 16; lower labials 9 on left side in one; ventrals from 135 to 141; caudals from 105 to 120. The oculars are invariably 1-2.

Color Pattern.—Gosse's description was:

Color reddish-brown above, softening to white below. An oblong mark of deep brown passes along the summit of the head, somewhat dilated before and behind: from this a

brown stripe extends all along the middle of the back, having a tendency on the nape to form confluent rhomboids. On each side of this a line of regular black dots passes down, and below these a narrow band of brown on each side. The dotted line as well as the dorsal stripe, become indistinct towards the tail, but the lateral line continues well marked. The latter pass through the eyes to the muzzle, and are succeeded on each cheek by two indistinct parallel lines. Chin and throat prettily spotted and marbled with dark brown on the white ground, the marks small and confluent. The body and especially the belly shields opaline. In age the ground-color becomes much darker, and the characteristic markings less distinct.

His last sentence makes one wonder whether he had a few large *funereus* which he mistook for adult *callilaemus*, as *callilaemus* is brick-red and Gosse's "brown" must be interpreted as a very reddish brown.

DISTRIBUTION.—Found by the writer under logs or trash on the hot, dry limestone plain, but the following locality records would indicate that it also inhabits forested areas. There is a possibility that some collections have *funereus* included with this species. The United States National Museum has it from Arntully, Balaclava, Windsor, Manchester, Mandeville, Hope Gardens, and Montego Bay; the British Museum from Bluefields and Springfield; and the Senckenberg Museum from Montego Bay. The writer took it at Kingston, Hope Gardens, and Boston Bay.

DISCUSSION.—Gosse described the species from two specimens. He gave the tails as $\frac{2}{5}$ and $\frac{1}{3}$ or 40 per cent and 33 per cent of the total length respectively. Ventrals 144 and 135; caudals 104 and 115; labial plates 6. It is evident that his measurements and counts lacked attention to detail. Barbour (1910: 300), records ventrals 130–151, the latter figure probably a miscount, and caudals 170–110, which is clearly an error. He says that he took 14 near Kingston and that Mr. Wright collected two in Mandeville and three at Port Antonio and that from the two latter stations the specimens were olive or dark brown. The writer believes that the specimens taken at Mandeville may have been *funereus*. Barbour says all the Kingston specimens were brick-red when adult. This agrees with the writer's findings and adds to the belief that Gosse had seen a large specimen of what was to be classified as *funereus* and believed it to be an adult *callilaemus*. Barbour (1914: 338) says that it has not yet been quite extirpated by the mongoose though it has become rare. The writer sees no reason to believe that these snakes have been seriously reduced in numbers by the mongoose on any of the large islands where he has collected. In places the mongoose has depleted or extirpated *Alsophis* and *Mabuya* and made serious inroads on *Ameiva*, but *Dromicus* is too retiring to suffer much. Schmidt (1928: 136) states that the representative in Puerto Rico was still fairly abundant, but that its secretive habits had preserved it from scientific collectors as well as from the mongoose. The writer found this to be true and by following a plow in a long fallow field he took many which had been hiding in the matted grass. Dunn (1932: 89) remarks that the usual list gives two species of *Dromicus* and no *Alsophis* from Jamaica, these two being *callilaemus* and *ater*, but that the latter is clearly an *Alsophis*, one *Dromicus* and one *Alsophis* being the arrangement for each island of the Greater Antilles.

Günther (1863: 357) described an old example as having body 432 and tail 127 mm., or nearly twice the size of our largest specimen. He makes no mention of this specimen having a broken tail, but this must have been the

case. He states the color to be uniform brown, anterior part of lower side somewhat lighter; a faint yellowish line from lower postocular to angle of mouth.

Leimadophis funereus (Cope)

Alsophis funereus Cope, Proc. Acad. Nat. Sci. Phila., 1862: 76–77.
Liophis callilaemus, Boulenger, Cat. Snakes Brit. Mus., 2, 1894: 142 (part).
Leimadophis callilaemus, Barbour, Bul. Mus. Comp. Zool., 52, 1910: 300 (part).

TYPE.—Lost, paratypes U.S.N.M. 5778 and 5780, Jamaica.

DESCRIPTION.—Adult female, writer's collection, No. 239. Rostral broader than high, scarcely visible from above; internasal suture shorter than prefrontal suture, latter not complete in this specimen only; frontal equal to its distance from end of snout, shorter than parietals, separated from preocular; supraocular narrower than frontal; nasal divided, longer than its distance from eye; loreal medium, pentagonal; one large preocular; two postoculars; one large anterior temporal followed by two smaller ones; seven supralabials, second in contact with posterior nasal, loreal and preocular; third and fourth supralabials in contact with eye; eight lower labials, four in contact with anterior chin-shield, two in contact with posterior; anterior chin-shields shorter than posterior ones; scales smooth, without pores, in 19 rows; ventrals, 136; anal divided; 78 pairs of subcaudals. The only variations noted were in the number of ventrals and subcaudals.

COLOR PATTERN.—Glossy slate black above; almost as dark underneath except throat and neck which are dark plumbeous; a light line from behind eye, bordered above by a fine black line which reaches to opposite third ventral; this line divides the plumbeous lower side of neck from the darker back; some specimens show fine white dots on the fifth row and some a wide dorsal stripe. There is little color change in alcohol.

DISTRIBUTION.—Apparently confined to higher, damper, forested parts of the island. The only specimens listed by any museum are the two in the U.S. National Museum. There are six in the writer's collection, taken at Bog Walk and Mandeville.

HABITS.—It is found under heaps of vegetation or rotting cocoanut husks in company with *Celestus*. This heavy bodied little snake is not so nervous or active as *callilaemus*. Nos. 239 and 240 contained large yolked eggs in the oviducts.

DISCUSSION.—Through the kindness of Dr. Stejneger I have the following notes on this species. He wrote July 8, 1937:

> Cope had before him three specimens collected in "Jamaica" by C. B. Adams, viz. U.S.N.M. Nos. 5778–5780. Of these he only mentioned No. 5779 in the original description. This one, which might be considered the type, was not on the museum shelves in 1889 and has not turned up since, but we have the paratypes 5778 and 5780, both of which are in good condition.
>
> Cope's original description mentions 17 scale rows, but both of the paratypes have 19, and Cope's counts are not always to be relied on. It gives the "total length of specimen" (presumably No. 5779) as "16 in." (ab. 406 mm.); "tail 5 in. 6 lines" (ab. 137 mm.). "General color black; anteriorly the inferior surface is plumbeous, as are also the superior labials." Now in alcohol, uniform dark brown.

Boulenger synonymizes this species with *Liophis callilaemus* which appears to have been the precedent for ignoring it in subsequent literature. As has been pointed out under *callilaemus* the anomalous presence of two species of

Dromicus on Jamaica, which Dunn believed eradicated, is re-established with this species.

The following table shows the differences between the species graphically save for color and proportions. *Dromicus funereus* is a heavier, stouter-bodied species, but measurements of soft bodies are unsatisfactory.

Serial No.	Snout to Vent	Vent to Tail Tip	Tail Total Length	Ventrals	Caudals	Caudals in % of Ventrals	Caudals in % of Ventrals and Caudals	Scale Rows	Upper Labials	Lower Labials	Locality
					Leimadophis callilaemus						
C.G. 420	236	172	.42	139	115	82	45	19–19–17	7	8	Hope Gardens
C.G. 536	219	158	.41	135	118	87	46	19–19–16	7	8	Kingston
C.G. 359	207	135	.39	139	105	75	43	19–19–17	7	8	Kingston
C.G. 761	152	110	.42	141	112	79	44	19–19–16	7	8/9	Boston Bay
C.G. 760	132	90	.40	135	120	88	47	19–19–17	7	8	Boston Bay
C.G. 1149	188	118	..	137	102	..	..	19–19–17	7	8/9	Kingston
C.G. 1150	210	155	..	135	115	85	46	19–19–17	7	8/9	Kingston
C.G. 1151	210	153	.42	136	112	82	45	19–19–16	7	8/9	Kingston
					Leimadophis funereus						
C.G. 239	300	135	.31	136	78	57	36	19–19–17	7	8	Bog Walk
C.G. 240	265	122	.31	136	79	58	36	19–19–17	7	8	Bog Walk
C.G. 333	221	119	.35	132	87	65	39	19–19–17	7	8	Mandeville
C.G. 1007	211	110	.34	140	88	63	38	19–19–17	7	8	Mandeville
C.G. 332	170	83	.32	133	84	63	38	19–19–17	7	8	Mandeville
C.G. 1076	168	72	.30	136	75	55	35	19–19–17	7	8	Mandeville
U.S.N.M. 5779	266	139	.34	..	..	..	..	–17–	7	..	"Jamaica"
U.S.N.M. 5778	236	140	.37	136	91	66	40	–19–	7	..	"Jamaica"
U.S.N.M. 5780	138	56	.28	130	70	54	35	–19–	7	..	"Jamaica"

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Migration of *Triturus viridescens*

By Kathryn F. Stein

On October 3, 1937, great numbers of *Triturus viridescens* were discovered near Sunderland, Massachusetts, apparently migrating into a small pond. Water from this pond runs over a dam, through a tunnel under a concrete road, and down a rocky declivity twelve to fifteen feet high into a very small stream which flows into the Connecticut River. Quite a few newts were found on the moist mossy bank, crawling over rocks, and on the sandy bottom of the brook, all of them with their noses pointed toward the falls. The greatest numbers, however, were on the rocks along one side of the falling water. The roughly perpendicular wall of rock was festooned with rows and clumps of animals struggling slowly and persistently upward. They were

thickest close to the edge of the falls where the rocks were always wet, but there was a scattering of individuals for some distance toward the side where the rock was worn away in a wide-open cave-like formation. Newts clambered out of the stream and then along the projecting moss and lichen-covered ledges toward the top of the falls where it emerged from the tunnel under the road. On October 3 a half hour's collecting yielded over a thousand animals with no apparent exhaustion of the supply. From six to twenty could be gathered with one scoop of the hand. Where they were most concentrated they crawled over one another in their eagerness to reach a destination beyond. Driven by some insistent urge they crawled upward against the rush of the water, often to be swept back, later regaining their lost foothold and beginning again their slow laborious climb. After they rounded the first supports of the bridge and entered the tunnel the going was fairly level and easy until they reached the dam where they were met by a perpendicular wall. Ascent here against the force of the water coming through the gate of the dam was impossible but the sidewalls offered foothold over the unevenness of natural rock overgrown with moss, lichens and creeping plants. From three to twenty newts were climbing this wall at different times, but they were never found here in greater numbers. Usually they followed a trickle of water leaking through a crack near the top. No more than forty were ever found at any one time between the entrance of the tunnel and the top of the wall of the dam.

After the discovery of the migration on October 3, visits were made daily for five days, two or three times a week up to October 18 and then about once a week until November 18.

On October 10 the tails of fifty individuals, found at a level half way up the rocks by the falls, were cut diagonally. Two days later one of these was found going through the tunnel and three were clinging to the side wall of the dam. No animals were ever seen actually to surmount the wall and get into the pond but the decrease in numbers between tunnel and dam from one day to the next indicates that they either did so or else went back over the falls. None were found crawling in the downward direction.

On October 15 a V-shaped cut was made in the tail fins of forty animals which had reached a higher level than those whose tails had been cut previously, but which were still a foot or more below the level of the tunnel. The next day one of the first marked lot was one of four, on the wall of the dam. Thirteen of the first lot and four of the second were discovered down in the bed of the stream. It seemed probable then, and became more evident later, that a drop in temperature caused most of the newts to leave the air and take to the water.

At various times animals were observed crawling over the land, sometimes toward the stream, sometimes away from it. These were no redder and therefore presumably not younger than those in the stream, so it is not certain that those approaching it were doing so for the first time.

October 23 was warm and rainy, and all the vegetation dripped with moisture. The salamanders on that day appeared to be more numerous, both on the land and on the rocks beside the falls, than at any time previously. Approximately 1200 were collected from the rocks, almost the entire popula-

tion of the fifty square feet of the principal salamander area. Collecting was begun at the bottom and by the time the upper regions were cleared the lower portions were again becoming populated while other animals were coming from the stream and from the land along its borders. The banks were literally crawling with scattered groups of salamanders. They climbed up on all sides, over rocks, up mossy tree trunks, along a path to the road, and across the road, to plunge, presumably, into the pond on the opposite side. One animal was actually observed until it reached its goal. It dropped into the water, hung a moment poised midway between the bottom and the surface, then swam quickly away. Fifteen live and as many dead animals were seen on the road over a distance of forty to fifty feet. Progress was apparently easier along this route than up the rocky wall and over the dam, but comparatively few of the newts found it.

DATA ON TEMPERATURE AND HUMIDITY OF THE AMHERST AND SUNDERLAND REGION IN RELATION TO APPROXIMATE NUMBERS OF *Triturus*

	Date	Temperature Min.	Max.	Midday	Humidity % (Mean)	Number of Animals on rocks by falls
October	3	39	59	57	71	Very many
	4	41	63	60	77	Very many
	5	53	74	70	79	Very many
	6	65	76	70	87	Very many
	7	48	69	64	54	Slight decrease
	8	35	52	51	53	Slight decrease
	9	26	54	52	63	
	10	41	49	48	79	Creeping into crevices
	11	36	51	50	68	
	12	31	66	61	71	Very many
	13	39	52	51	54	
	14	24	51	50	66	
	15	26	48	44	64	Decrease
	16	28	50	48	54	Same
	17	21	55	50	65	Same
	23	55	67	64	85	Very many
	25	29	54	51	63	Fewer
	28	49	52	51	90	Many (many on land also)
November	1	23	51	39	69	Fewer
	9	46	63	63	56	Increase
	18	32	44	43	57	None

October 25 was cold and the volume of water pouring over the falls was much increased by recent rains. About 200 animals were on the rocks and there were others in the stream bed. By November 9, following warm weather, the number had increased to about 500. The newts were last visited on November 18 when the rocks were deserted and only a few animals could be seen here and there in the stream. At the edge of the water and in a small separate pool, under layers of dead leaves, several groups of seven to twelve animals were discovered. Perhaps the fine silt under them was to serve as their hibernation quarters since it seemed unlikely that they would reach the pond that season.

MOUNT HOLYOKE COLLEGE, SOUTH HADLEY, MASSACHUSETTS.

Herpetological Notes

HISTORY OF A PARATYPE OF *CROCODYLUS MINDORENSIS*.—The name of Dr. Joseph B. Steere, the veteran zoologist and ethonologist, is familiar in Field Museum since a part of his Philippine collections was purchased in the early days of the Museum, and reported upon, in part, in the Museum's publications. At the suggestion of F. M. Gaige, in the course of a recent visit in Ann Arbor, it was my privilege to call upon Dr. Steere at his home in the outskirts of the city.

In the course of conversation Dr. Steere told us about collecting a medium-sized crocodile on the island of Mindoro, on his Philippine trip of 1887–88. Entering Mindoro at Calapan he had proceeded up the Catuiran River, and camped on high ground after two days of travel inland toward Mt. Halcon. At this place a bull tamarau was shot, one of the types of his subsequently described *Bubalus mindorensis*. The carcass was used by his native assistants as bait for crocodiles, in the adjacent river, and a moderate-sized specimen was caught. This specimen was trussed, its limbs tied over its back, its jaws tied, and it was then tethered to one of the supports of Dr. Steere's hammock. In the night Dr. Steere was awakened by a disturbance, and in sitting up kicked against his mosquito net, which received a violent bite from the captive crocodile, whose jaw rope had become dislodged. The animal's teeth were entangled in the net, and he called the Philippine boys to remove it from his vicinity for the rest of the night. The specimen was prepared on the following day. Dr. Steere estimated its length at about eight feet. This incident is described in his own vivid account of the tamarau hunt (1891, Amer. Nat., 25; 1051); but I found this reference only as a result of our conversation.

It seems certain that the skull of this specimen is the one recorded as a paratype, without certain data, in my description of *Crocodylus mindorensis* (1935, Zool. Ser. Field Mus. Nat. Hist., 20: 68). There is no other record of Dr. Steere's specimen, the preparation of which he so well remembers; a considerable share of his Mindoro collection reached Field Museum, and the size corresponds excellently with his recollection of the specimen. With no one especially interested in crocodiles, it is not surprising that the data for this skull should have been lost in the long period during which it alternately gathered dust and was moved about in Chicago. My own discovery of its exact correspondence with the smaller specimens of the Mindoro crocodile obtained for the Crane Pacific Expedition by the Bureau of Science, was only made possible by the cleaning of the skull, in the course of a general "clean-up" of odds and ends of material without data.

Since the type and remaining paratypes of *Crocodylus mindorensis* were without indication of a precise locality on Mindoro, this locality record forms an important supplement to the description.—Karl P. Schmidt, *Field Museum of Natural History, Chicago, Illinois.*

A NEW RECORD OF *PLETHODON VEHICULUS* (COOPER) FROM VANCOUVER, BRITISH COLUMBIA.—On March 17, 1937, two specimens of *Plethodon vehiculus* were brought into the laboratory from the forest reserve on the campus of the University of British Columbia. The forest consists largely of Douglas fir and alder with a dense undergrowth and much decaying plant matter on the floor. The animals were found, along with two specimens of *Ensatina eschscholtzii*, by workmen who were clearing away the underbrush and alder. One of the specimens of *P. vehiculus* measured 96 mm., the other 65 mm. in length. In both the dorsal stripe was red, the sides of the body dusky brown, and the ventral surface grey with numerous white, irregularly-shaped spots.

During the past six years these woods have provided a fruitful collecting ground for *Ensatina eschscholtzii*, which has been taken there by the author on frequent occasions. This is the first time, however, that *Plethodon vehiculus* has been noted in this area. It has previously been reported from Burnaby, a suburb of Vancouver about 11 miles away, and from several localities on Vancouver Island. There is also a doubtful record of its presence in the Okanagan Valley in the interior of the province.—Gertrude Smith Watney, *University of British Columbia, Vancouver, Canada.*

AN ADDITION TO THE LIZARD FAUNA OF TENNESSEE.—Among the reptiles and amphibians collected by W. M. Perrygo and C. Lingebach in the Great Smoky Mountains, Tennessee, in the spring of 1937, was a pair of *Anolis carolinensis* (now U.S.N.M. Nos. 103129–30), apparently new to the state. These were taken at Waynesboro in Wayne County on March 13, and another specimen (103007) was captured on Big Frog Mountain, in Polk County, at an altitude of 2250 feet on July 12. Mr. Perrygo says that these lizards were very common at Waynesboro, where they could be seen every sunny morning on the tree trunks, nodding their heads and distending their bright dewlaps.—Doris M. Cochran. *U. S. National Museum, Washington, D.C.*

NOTES ON THE EGGS AND HABITS OF *HYPOPACHUS CUNEUS* COPE.—Little seems to be known of the habits of *Hypopachus cuneus*. Wright and Wright (1933, Handbook of frogs and toads) discuss the breeding habits and briefly describe the tadpole. The senior author has observed the eggs being laid 24 hours after the beginning of heavy rains from April to October. These hatched in approximately 12 hours, and the tadpoles transformed in about 30 days. The gills disappeared within approximately 30 hours after hatching.

A complement of approximately 700 eggs was taken from a copulating pair of *Hypopachus cuneus*, at Edinburg, Texas, on September 24, 1935. They are black and white and measure with the single envelope 1.5 to 2 mm. Without the envelope they measure about 1 mm. The eggs float on the surface of temporary pools in rafts loosely held together. These eggs resemble those of *Gastrophryne* in that the envelope is truncate, and they float with this flattened surface upward.

Adults driven from under mesquite trees during irrigation were found to have been feeding on termites and minute dipterous insects. Specimens in captivity likewise fed readily upon termites. Even though buried several inches underground, while in captivity, the placing of termites upon the surface readily brought them into the open. In the natural state, however, they do not come into the open except when driven out by excessive rains. They invariably are to be found in burrows, among the trash of pack rats, and in the hollows under trees. As humidity decreases, they apparently seek out deeper and more moist situations, or burrow backwards into the soil, where they are not subjected to rapid drying out.

The call of *Hypopachus cuneus* is a bleat about three or four tones lower than that of *Gastrophryne olivacea* but much more resonant. Calls last about two seconds and are seldom repeated at less than 15 second intervals, often at much longer intervals. Whereas *Gastrophryne* prefers to support itself at the surface by some vertical object, *Hypopachus* generally floats free at the surface, and from these positions the calls are made. After rains cease, *Hypopachus* becomes silent long before *Gastrophryne*.—Stanley Mulaik, *Edinburg, Texas*, and Dwight Sollberger, *Cornell University, Ithaca, New York*.

OBSERVATION OF THE SURVIVAL VALUE OF THE CHARACTER OF THE BLUE TAIL IN *EUMECES*.—Collectors of lizards frequently find after securing their specimens that the slender tail has been lost. This is particularly annoying in the case of the three species of *Eumeces* (*E. fasciatus, E. laticeps, E. inexpectatus*), the blue-tailed skinks, that are so abundant in our southeastern states. In these species the tail is colored a brilliant blue during part or all of the life of the lizard, and is of some importance to the naturalist interested in identifying them. During a recent trip to South Carolina Mrs. Jopson and I had the opportunity to observe what may happen when one of these lizards is attacked by a predator. Our dogs, a terrier and a spaniel, cornered a small blue-tailed skink, and in the ensuing excitement the tail of the lizard came off, being either dropped by autotomy or knocked off by one of the dogs. The severed tail lay writhing on the ground, attracting the attention of the dogs, one of which seized it, while the lizard fled to safety. On another occasion we saw the same dogs succeed in catching a large *Eumeces* that had reached the red-headed, or "scorpion" stage. The bright color of the tail had been lost, and although that member came off in the encounter, its loss failed to save the skink. These two observations would seem to lend some support to the supposition that the bright color of the tail of these lizards, coupled with the ease with which that member is lost, is of definite survival value.—Harry G. M. Jopson, *Bridgewater College, Bridgewater, Virginia.*

HYDROMANTES PLATYCEPHALUS IN SONORA PASS, CALIFORNIA.—The Mt. Lyell salamander, *Hydromantes platycephalus* (Camp), has been reported heretofore only from within the boundaries of Yosemite National Park. The types were from the foot of Lyell Glacier and several specimens have been collected there since. Others have been taken on the top of Half Dome, by students of the Yosemite Nature School and later by Mr. Wilbur V. Henry of Stanford University (specimens in Stanford collection).

In the spring of 1931, Dr. T. I. Storer told me that he had collected a single Lyell salamander under the boulders of a rock slide near the summit of Sonora Pass, to the north of the park, and on May 1, 1931, I searched there for the species. The top of the pass was still blocked with snow but the ground under the boulders of the slide was dry. Seven specimens were found, all under one large, flat rock a hundred yards or so from the road on the Alpine County side, and just to the west of the boulder slide. The rock was kept dripping by the splash of a small waterfall from a snowbank. The exact locality was six-tenths of a mile above Chipmunk Flat on the west slope of the pass. Specimens from this lot are in the collections of Stanford University, the U. S. National Museum, the Museum of Comparative Zoology, and Mr. L. M. Klauber. One specimen was sent to Dr. Storer. The Sonora Pass locality extends the range over forty miles northward from Half Dome and Lyell Glacier, and the salamander is probably to be found in suitable places both to the north and south of the park.—GEORGE S. MYERS, *Stanford University, California.*

DISTRIBUTION OF TURTLES IN COASTAL BRITISH COLUMBIA.—A recent article by Dr. T. I. Storer (COPEIA, 1937: 66–67) on the turtles of the Pacific northwest revives the question of turtle distribution in southern British Columbia. Dr. Storer is evidently in favor of disregarding Lord's records (The Naturalist in British Columbia, 2, 1866: 100 and 301), and it is evident from descriptions and from distribution notes given by Lord that he did not distinguish between *Clemmys marmorata* and *Chrysemys belli.* While this failure to distinguish between the two genera renders Lord's notes of little value from the standpoint of specific distribution maps, nevertheless it is hardly likely that he would confuse a turtle with any other vertebrate inhabitant of the regions he traversed. We can safely assume therefore that where Lord records *"Actinemys marmorata,"* turtles did occur at that time.

Besides being wide-spread throughout southern British Columbia east of the Cascades from the East Kootenay west almost to the Fraser River (Cowan, Ann. Rep. B. C. Prov. Mus., 1936, 1937: 23), *Chrysemys bellii bellii* occurs in the coast district at Pender Harbour, on Texada Island in the Gulf of Georgia, and in several small lakes in the Alberni district of Vancouver Island. I have examined specimens from all these localities. There is no reason to suppose that the species does not occur at other localities in the coast district, as much of western British Columbia is still zoologically unknown. It has been suggested that these coastal specimens of *Chrysemys* are descended from escaped pets, but if this were true one could expect them to occur in lakes adjacent to human habitation rather than in lakelets for the most part removed from frequent human association, as is the case. This present distribution, coupled with the recorded presence of turtles on Vancouver Island in 1858 (Lord, *loc. cit.*), hardly makes it necessary to assume transplantation to explain their presence west of the Cascades.

In the early summer of 1933, Mr. Kenneth Racey picked up a turtle near Burnaby Lake, Vancouver, which I was able to examine, photograph, and verify as *C. marmorata.* This specimen unfortunately subsequently escaped. This is the only recent record of *Clemmys marmorata* in British Columbia.—IAN MCTAGGART COWAN, *British Columbia Provincial Museum, Victoria, British Columbia.*

AMPHIBIANS AND REPTILES OF A 2,220-ACRE TRACT IN CENTRAL MISSOURI.—East of Ashland, Boone County, Missouri, in the Missouri River hills, the Land Utilization Division of the Resettlement Administration is developing for the University of Missouri a tract of land to be used as an arboretum and wildlife experimental area. In 1935 and 1936 the writer made a preliminary reconnaissance of the vertebrates dwelling here, as the first step in the inventory which is necessary to a research program.

About half of the area is wooded, with white oak and hickory predominating on

the ridges, sycamore, sugar maple, and elm in the two stream valleys. The slopes are steep and stony; they and the dozen abandoned upland farms are badly eroded. The northern part of the area, however, is covered by the loose soil characteristic of the northern Missouri prairies.

While an attempt was made to study the population density of some of the larger snakes, the results were uncertain and are not recorded here. In the following list, the amphibians were identified by Dr. S. C. Bishop, of the University of Rochester, and most of the reptiles by Dr. F. N. Blanchard, of the University of Michigan. The writer's thanks are due these gentlemen for their assistance.

AMPHIBIANS

Triturus viridescens viridescens Rafinesque. Crimson-spotted newt.
Plethodon glutinosus (Green). Slimy salamander.
Bufo americanus americanus Holbrook. American toad.
Bufo fowleri Hinckley. Fowler's toad.
Acris gryllus (LeConte). Cricket-frog.
Pseudacris nigrita triseriata (Wied). Swamp tree-frog.
Rana pipiens Schreber. Leopard frog.
Rana palustris LeConte. Pickerel-frog.
Rana catesbeiana Shaw. Bullfrog.

REPTILES

Sceloporus undulatus (Latreille). Fence swift.
Eumeces fasciatus (Linnaeus). Blue-tailed skink.
Eumeces laticeps (Schneider). Red-headed lizard.
Leiolopisma unicolor (Harlan). Brown-backed skink.
Carphophis amoena vermis (Kennicott). Worm-snake.
Diadophis punctatus arnyi (Kennicott). Ring-neck snake.
Heterodon contortrix (Linnaeus). Hog-nose snake.
Opheodrys aestivus (Linnaeus). Rough green-snake.
Coluber constrictor flaviventris (Say). Blue racer.
Elaphe obsoleta obsoleta (Say). Pilot black-snake.
Lampropeltis getulus holbrooki (Stejneger). Holbrook's king-snake.
Lampropeltis calligaster (Harlan). Evans' king-snake.
Natrix sipedon sipedon (Linnaeus). Common water-snake.
Thamnophis sirtalis sirtalis (Linnaeus). Garter-snake.
Thamnophis sauritus proximus (Say). Western ribbon-snake.
Agkistrodon mokasen mokasen Beauvois. Copperhead.
Crotalus horridus horridus Linnaeus. Common rattlesnake.
Chelydra serpentina (Linnaeus). Common snapping-turtle.
Terrapene triunguis (Agassiz). Southern box-turtle.
Terrapene ornata (Agassiz). Painted box-turtle.
Amyda spinifera (Le Sueur). Soft-shelled turtle.

WILLARD L. HENNING, *Camden, Ohio.*

TYING OFF THE POISON DUCTS IN RATTLESNAKES.—In the last issue of COPEIA I read with interest the paper on *Surgical removal of the poison glands of rattlesnakes*. The technique for this operation was carefully worked out, but why is so mutilating an operation necessary? If the duct from the gland to the venom injecting teeth is cut or tied, no venom can be expressed; and the further surgical shock from dissection of the gland itself with its disfiguring results can be eliminated. An analogous case in connection with de-odorizing our common skunk is discussed by Dr. C. Hart Merriam in *The vertebrates of the Adirondack region* (1882). In writing of the possibility of removing the scent glands, he cites a much simpler procedure. "It consists of making an incision through the skin, directly in front of the anus and in snipping the ducts of the glands at the bases of the nipple-like papillae which project into the gut, just within the sphincter. . . . Therefore, although the glands themselves are left in situ, the animal is forever after incapable of ridding himself of the contents."

Another illustration of my point is the sterilizing of human beings, for adequate cause, by tying off the spermatic cords in males and Fallopian tubes in females, without the mutilating operations of removing the testes or ovaries.—HAROLD L. BABCOCK, *Boston Society of Natural History, Boston, Massachusetts.*

NOTES ON SOME REPTILES AND AMPHIBIANS FROM CENTRAL VERMONT.—During the last two weeks of August, 1937, the authors spent some time collecting in the vicinity of Stowe, in the heart of the Green Mountains, in the central portion of Vermont. The list of the species obtained follows.

Triturus viridescens viridescens Rafinesque.—All stages of this species, the gilled larvae, the red eft, and the adult aquatic, were found.

Plethodon cinereus (Green).—Very common under rocks and logs. Specimens from the mountains seem to be larger than those from the lower elevations. They also differ somewhat in color, being intermediate between the red-backed and the gray phases. The ones from the lower elevations were the typical red-backed form.

Gyrinophilus porphyriticus (Green).—A single specimen of this species was secured in a clear and cold mountain stream.

Eurycea bislineata bislineata (Green).—This species was very common in streams along with the dusky salamander.

Desmognathus fuscus fuscus (Rafinesque).—Very common in all the fresh-water streams around Stowe, outnumbering even *Eurycea bislineata*.

Bufo americanus Holbrook.

Rana pipiens Schreber.

Rana palustris LeConte.

Rana catesbeiana Shaw.

Rana clamitans Latreille.—This species was quite plentiful. It was found on the banks bordering bodies of water and in swampy areas. Vermont specimens seem to be larger than those of this species in the South, and they differ also in having black blotches scattered over the back.

Rana sylvatica LeConte.—This form was common in the vicinity of small brooks in damp pine woods.

Diadophis punctatus edwardsii (Merrem).—One specimen was secured under a ledge of shale on a pastured hillside.

Lampropeltis triangulum triangulum (Lacépède).—A single specimen was taken in a field near a group of farm buildings.

Storeria occipitomaculata (Storer).—This species was about as common as the garter snake. Both the typical chestnut brown phase and the gray phase were collected.

Thamnophis sirtalis sirtalis (Linnaeus).—This was the most abundant species of snake.—J. A. Fowler and H. J. Cole, *Zoology Dept., George Washington University, Washington, D. C.*

THE NAME OF THE WESTERN CORAL KING SNAKE.—The argument over the proper name of the western coral king snake boils down to whether the case is to be considered on nomenclatural or zoological grounds; Burt (Copeia, 1936: 94) starts his arguments on the former basis and ends up on the latter. Those who agree with Burt's identification of Blaineville's *Coluber zonatus* will, of course, apply that name to the western coral snake, calling it *Lampropeltis zonata* (Blaineville), and need not consider any nomenclatural points at all. On the other hand, those who believe *Coluber zonatus* unidentifiable must determine what effect this name has on *Bellophis zonatus* Lockington.

Stejneger (as quoted by Burt) clearly believes that Lockington thought his species to be the same as Blaineville's and applied Art. 31, " . . .a specific name which undoubtedly rests upon an error of identification cannot be retained for the misdetermined species even if the species in question are afterwards placed in different genera." This view necessitates the adoption of Yarrow's name *multicinctus*.

I cannot follow Hubb's reasoning (also in Burt's paper, last two lines of the small type beginning top of page 96) that "the species should be known either as *L. zonata* (Blaineville) or *L. zonata* (Lockington) . . . ." It seems to me that Lockington is out of it altogether unless he independently described and named *Bellophis zonatus* without reference to Blaineville.

The International Commission's Opinion 65, "Case of a genus based upon erroneously determined species," bears upon this question.—James L. Peters, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

THE GENERIC NAME OF THE NORTH AMERICAN GROUND SNAKE.—Unfortunately the generic name *Potamophis* Fitzinger 1843 (type *Coluber striatulus* Linnaeus) usually applied to the North American ground snake is preoccupied by *Potamophis* Cantor 1836 (Trans. Med. Phys. Soc. Calcutta, 8: 139) This earlier generic name was applied to an opisthoglyphous Indian river-snake, and the monotype is *P. lushingtonii* Cantor 1836 *(loc. cit.)* which appears to be a synonym of *Hydrus enhydris* Schneider 1799 (=*Hypsirhina enhydris auct.*). The first acceptable generic name for the Nearctic snake would seem to be *Haldea* Baird and Girard 1853 (Cat. N. Amer. Rept., Pt. 1: 122) whose monotype is the same as that of *Potamophis* Fitzinger nec Cantor.—H. W. PARKER, *British Museum (Natural History), London, England.*

ON THE OCCURRENCE OF *DERMOCHELYS CORIACEA* (LINNAEUS) OFF THE MAINE COAST.—On August 25, 1937, while a party of men were deep sea fishing five miles southeast of Sequin Island (off Booth Bay Harbour), Maine, a large turtle was seen swimming on the surface near the motor boat. The huge size of the turtle excited the party and an attempt was made to capture it at once.

With the engine running at trolling speed the boat ghosted along quietly, but at its approach the turtle dived. Presently it reappeared, and on second trial allowed the craft to come alongside. One of the men immediately drove a harpoon into its shell. With a swirl of foam the animal dived again, taking out about 75 feet of rope as well as a barrel which had been fastened near the harpoon shaft. Meanwhile three men had launched one of the dories, and as soon as the downward pull on the line slackened they began to haul in the rope hand over hand. All their strength was needed to warp in the captured animal. The huge beast struggled awkwardly and repeatedly tried to shake out the harpoon. As the turtle broke water it turned over and the sea around was crimson with blood. The dorymen had been at least 20 minutes getting near enough so that one of them could try to knock the animal over the head with an oar. This treatment, however, affected the turtle not at all. Eventually a rifle was found and when the animal was within a range of 3 feet a .22 bullet was put squarely into its head.

As the carcass was pulled over the side of the motor boat by block and tackle, the fisherman observed five striped fish which had followed it to the surface. One 14 inches long was speared.

The specimen measured 7½ feet in total length from head to the hardened posterior tip of its carapace. The weight was estimated at 1200 to 1500 pounds. The trunk-back is distinguished from all other marine turtles by the absence of horny plates, its shell being tough leathery skin, blackish brown, and the carapace having seven characteristically scalloped longitudinal ridges. The turtle's massive head was supported by an enormously thick, short neck. Its jaws were short, heavy, and notched, giving its mouth the appearance of great power and ferociousness. The two pairs of flipper-shaped swimming limbs had enabled it to tow the dory for 20 minutes, even though pierced with a harpoon.

The men who caught the turtle wanted to exhibit it so that anything more than a superficial examination was not permitted. The carcass remained on the pier at West Southport for a few days and then was put in the water again and tied to a buoy. A storm eventually bore it away.

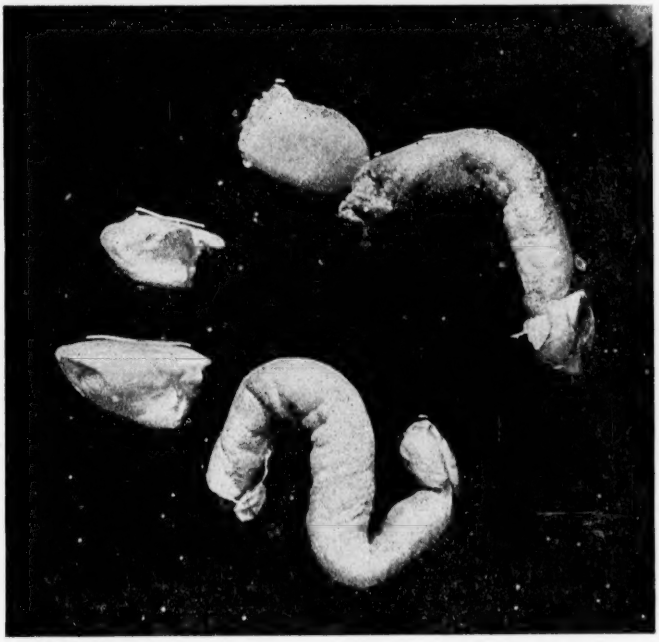
None of the local fishermen had ever seen a trunk-back turtle before, so that the species is probably an infrequent visitor to this part of the Maine coast. I have not been able to find any other Maine records.

I was not present at the capture of the turtle and am indebted to Dr. G. W. Elderkin, Dept. of Archeology, Princeton University, for an eye-witness account. I examined the turtle at Southport.—GEORGE WHITELEY, JR., *Science Dept., Mill School, Pottstown, Pennsylvania.*

Ichthyological Notes

HERMAPHRODITISM IN A WALL-EYED PIKE *(STIZOSTEDION VITREUM)*.—The gonads of a 14-inch hermaphrodite wall-eyed pike were presented to the author by a student who stated that the specimen was collected, during the second week of April, 1933, in Chittenango Creek at Bridgeport, New York, which is not far from Oneida Lake. Wall-eyed pike ascend this creek in large numbers to spawn, and despite the vigilance of the protective force many are taken by poachers. The specimen in question was collected under such circumstances and it was due to this fact that it was impossible to secure the entire fish.

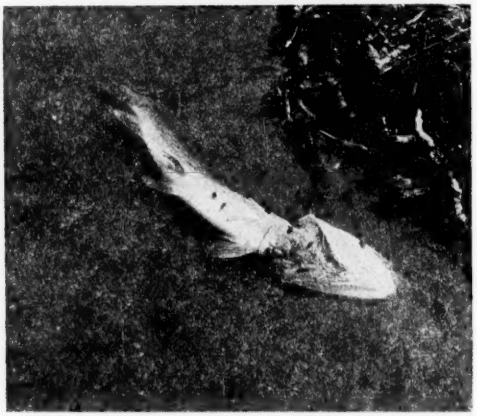
The gonads were nearly 15 cm. in length and the lobes were essentially equal in size and in the distribution of the elements. The lobes were characterized by a central portion, approximately 9 cm. long containing the ova, and a knob-like sac at each end of each lobe containing the spermatozoa. The "knobs" at one end were 4 cm. in length, those at the other 2 cm. They were slightly wider than the ovary; varying from 2 to 3 cm.



As may be seen in the illustration the "knobs" at the left were very loosely connected with the ovary while those at the opposite side (still intact) were more secure, its covering tissue being continuous with that of the ovary; and there was a distinct constriction between the two parts.

The ova were about one mm. in diameter and appeared to be mature. The spermatozoa were active. The circumstances under which the pike-perch was found suggests that it had felt the spawning urge and had entered the spawning grounds for that purpose.—WILFORD A. DENCE, *Roosevelt Wildlife Forest Experiment Station, Syracuse University, Syracuse, New York.*

AN UNUSUAL FEEDING INCIDENT IN THE GREAT NORTHERN PIKE *(ESOX LUCIUS).*—It is generally known that the great northern pike (*Esox lucius*) is extremely voracious and feeds indiscriminately on other fish. The stomachs of certain individuals have been known to contain slender fish that were nearly as long as the predators themselves. Ordinarily species with spiny rays can be devoured with ease if they are not too large and are manipulated head first. However, the species having such deep, compressed bodies as the sunfish are unwieldly and also difficult to eject if the necessity arises. A 25-inch pike at Cross Lake, Onondaga County, New York, was confronted with this problem on June 29, 1931. This fish had seized a 7-inch rock bass *(Ambloplites rupestris)* which, obviously, was too large for it to swallow. The pike with the rock bass still in its mouth was found floating near shore by the writer, and it had been dead only a few hours. The head of the rock bass was firmly lodged in the esophagus while its right eye, cheek and operculum were, as the result of rupture, exposed at the opercular opening of the pike. The caudal fin and the tip of the anal fin protruded from the pike's mouth. The pharynx of the pike was badly torn, while the isthmus was severed at the pectoral girdle.



I believe that the damage to the pike was not caused through the efforts of the rock bass to escape but rather by the pike itself in its struggle to disgorge its prey. The pike apparently was greatly handicapped in this process because some of the stiff spines of the rock bass were firmly lodged in the tissues of its mouth.—WILFORD A. DENCE, *Roosevelt Wildlife Forest Experiment Station, Syracuse, New York.*

PORONOTUS TRIACANTHUS IN MALPEQUE BAY, PRINCE EDWARD ISLAND.—In a recent note in COPEIA (4, 1937: 238) William S. Hoar reported the occurrence of two butterfish (*Poronotus triacanthus* Peck) near Margaree Harbour, Cape Breton Island, on July 20, 1937. He points out that although repeatedly taken on the outer coast of Nova Scotia as far north as Canso, they have been reported from the Gulf of St. Lawrence only once.

It is interesting to note in this connection that a specimen of this species was taken in a gill net on September 19, 1932, at Bird Island cove, Malpeque Bay. The specimen was 13 cm. long. The gill-net was of a 2½ inch mesh set at the surface in water about 10 feet deep and the butterfish was gilled near the surface.

Butterfish, though not abundant, may be more common in the Gulf of St. Lawrence than the records indicate. Judging from their occurrence eleswhere, they are probably only summer visitors to the Gulf and would come in contact with relatively little gear suited to their capture.—A. W. H. NEEDLER, *Prince Edward Island Biological Station, Ellerslie, Prince Edward Island.*

SOME FISH RECORDS FROM THE COAST OF BRITISH COLUMBIA.—During the past two years the Provincial Museum has acquired certain specimens of salt water fishes from the west coast of Vancouver Island, British Columbia, which in view of their rarity in Canadian waters seem to merit comment. For the most part these have been received through the cooperation of the Kyuquot Trollers and the Sooke Harbor Fishing and Packing Company, to whom the Museum extends its thanks.

Alopias vulpes (Gmelin); thresher shark.—A specimen of this shark was taken in the fish traps operated by the Sooke Harbour Fishing and Packing Company at Otter Point, near Sooke, V.I., on July 19, 1937. This individual measures 5 feet 8½ inches of which the head and body comprise 2 feet 8½ inches, the caudal fin, 3 feet. In so far as I am able to ascertain, this is the first recorded instance of the thresher occurring in British Columbian waters.

Sphyraena argentea Girard; barracuda.—A single individual 29 inches in length to the caudal notch was taken at Sooke, V.I., August 5, 1937.

Germo alalunga (Gmelin); long-finned albacore.—A small individual taken August 17, 1937, on a salmon troll off Kyuquot, V.I., B.C., and presented to the Museum, is the only specimen of this species in the collections.

Lampris luna (Gmelin); moon fish.—First reported from British Columbian waters in August, 1935 (Progress Reports, Pacific Biol. Stat., 25: 12), when one was taken at Tofino, V.I., this fish has since been of regular occurrence. During the summer months of 1936 and 1937 the trollers fishing out of Kyuquot Sound, V.I., report catching several of these strikingly beautiful fish. One of our specimens was taken off Kyuquot on July 18, 1936; the other off Cape Cooke, V.I., B.C., September 27, 1937.

Icichthys lockingtoni Jordan and Gilbert; scaly ragfish.—A small ragfish taken from the Sooke fish traps August 5, 1935, and presented to the Museum, was identified as this species by Mr. G. Van Wilby of the Pacific Biological Station.

Acrotus willoughbyi Bean; brown ragfish.—This ragfish seems to be of sufficient rarity for any occurrence to be of interest. In the past two years two specimens have come to our attention. The first of these, a large one, 6 feet 10 inches in length, was taken in the Sooke fish traps on August 27, 1935. Two small boys fishing from the breakwater at Victoria, B.C., in July, 1936, took an even larger individual, which however was so badly mutilated as to be worthless.

A possible clue to the usual habitat of this ragfish is offered by Dr. L. L. Robbins of the University of Chicago. From specimens here he recently identified an unknown fish forming a large part of the food supply of sperm whale taken in deep water off the Queen Charlotte Islands. Dr. Robbins is confident that the "bastard halibut" of the whalers is identical with the brown ragfish.

Brama raii (Bloch); pomfret.—Our most recently acquired specimen of this fish was taken on a salmon troll off Cape Cooke, V.I., on September 27, 1937.

Alepisaurus ferox Lowe; hand-saw fish.—So far as I am aware, most of the specimens of this fish in collections have been found cast up on shore. Accordingly notes concerning the capture of a specimen sent to us in July, 1937, are of interest. The notes, furnished by Mr. A. J. Hepburn, of the Kyuquot Trollers Cooperative Association, are as follows. "This fish was taken on a trolling spoon about eight miles off the lighthouse on Kairns Island at the mouth of Quatsino Sound. The water at this point is somewhere between 50 and 70 fathoms in depth and the bottom is gravel although mud bottom is not far off. A few miles further out the bottom drops off rapidly to ocean depths. The man who caught this fish was at the time trolling with 40 fathoms of wire and 45 pounds of lead which would put the spoon approximately 30 fathoms from the surface."

Mr. Hepburn further states that " . . . four years ago I attempted to send you one of these fish . . . taken on halibut gear in Brooks Bay [off Klaskino Inlet, V.I.] over gravel bottom at about 30 fathoms."—IAN MCTAGGART COWAN, *British Columbia Provincial Museum, Victoria, British Columbia.*

NOTES ON *ANSORGIA, CLARISILURUS, WALLAGO,* AND *CERATOGLANIS,* FOUR GENERA OF AFRICAN AND INDO-MALAYAN CATFISHES.—In 1933 (Amer. Mus. Novit., 656: 5) Nichols and La Monte described a supposed new genus of schilbeid catfishes, *Eutropiellus* (type *E. kasai* Nichols and La Monte), from the Congo. I see nothing to distinguish this fish from *Ansorgia vittata* Boulenger 1912 (see Boulenger, Cat. Freshw. Fishes Africa, 4, 1916: 294), a genus and species with which Nichols and La Monte were apparently not familiar. *Eutropiellus kasai* falls as a synonym of *Ansorgia vittata.* However, Whitley (Rec. Austr. Mus., 19 (4), 1935: 249) has recently pointed out that *Ansorgia* Boulenger 1912 is preoccupied by *Ansorgia* Warren 1899 (Lepidoptera) and he proposes *Ansorgiichthys* to replace Boulenger's name. It scarcely need be pointed out that *Eutropiellus* Nichols and La Monte is older than Whitley's name and that the Congo siluroid must be known as *Eutropiellus vittatus* (Boulenger).

Very recently Fowler (Proc. Acad. Nat. Sci. Phila., 89, 1937: 133, figs. 5, 6) has described a supposed new genus of catfishes from Siam as *Clarisilurus* (type *C. kemratensis* Fowler), placing the genus in the restricted family Siluridae. From Fowler's description, I can see nothing to show that this supposed silurid is anything but the common Indian clariid genus *Heteropneustes* (*Saccobranchus*). Whether the species *C. kemratensis* Fowler is identical with *H. fossilis* or not I do not know, and it is of course possible that Fowler's fish may actually be generically distinct from *Heteropneustes.* However, the description shows no differences of note and the placement of the genus in the Siluridae and the absence of comparison with *Heteropneustes* make me feel certain that an egregious error has occurred.

In 1851 (Nat. Tijdschr. Ned. Indië, 2: 202), Bleeker described a new species of catfish from Banjermassin as *Wallago dinema.* This was the first appearance in print of the generic name *Wallago* but no generic characterization was made. Under Article 25 of the International Rules, this mention is sufficient to establish the generic name *Wallago,* with *W. dinema* Bleeker as its genotype by monotypy. It is perfectly evident, therefore, that *Wallago* must replace *Belodontichthys* Bleeker 1858, whose monotype is *macrochir* (=*dinema*). The genus usually known as *Wallago* is left nameless, and I propose for it the new genus ***Wallagonia,*** the genotype being *Wallago leerii* Bleeker, the only species of which I have examined good material. The diagnosis of *Wallagonia* is that given by Weber and de Beaufort for *Wallago* (Fish. Indo-Austr. Arch., 2, 1913: 200). The present note was written practically in this form before Hora (Rec. Ind. Mus., 38, 1936: 207) had worked out the nomenclature, but he did not take the obviously necessary step of renaming *Wallago* (*auctorum*) and tells me that he does not wish to do so. Three species enter the new genus, *Wallagonia attu, W. miostoma,* and *W. leerii.*

Examination of a fine specimen of *Hemisilurus scleronema* Bleeker from Siak, Sumatra, in the U.S. National Museum, has convinced me that this remarkable fish is generically distinct from the other species referred to *Hemisilurus.* Pending the publication of some studies on the Asiatic silurids, I propose the new genus ***Ceratoglanis,*** type *Hemisilurus scleronema* Bleeker, distinguished from *Hemisilurus* by the situation of the posterior nostrils before the vertical of the front of the eye (instead of entirely behind and above the eye) and the possession of short, bony, hooked, maxillary barbels. It may be remarked that Weber and de Beaufort's classification of the Malayan silurid catfishes, based largely on the degree of development of the dorsal fin and the presence or absence of pelvics, is certainly artificial to a considerable degree, and needs fundamental revision. —GEORGE S. MYERS, *Stanford University, California.*

A NEW TUNA RECORD FROM WASHINGTON.—On August 6, 1937, the purse seine boat *Lina B* took a specimen of a bluefin tuna (*Thunnus thynnus*) in a catch of sardines about 25 miles off Willapa Bay, Washington. Since then a second specimen has been taken by the purse seine boat *Martindale* off the mouth of the Columbia River, where bluefin tuna have been previously recorded. Both specimens were small, the first weighing about 8 pounds, the second about 12 pounds.—VERNON E. BROCK, *Fish Commissioner of Oregon, Portland, Oregon.*

REVIEWS AND COMMENTS

VERGLEICHENDE STUDIEN ÜBER DIE MORPHOLOGIE UND HISTOGENESE DER LARVALEN HAFTORGANE BEI DEN AMPHIBIEN. By Ingvald Lieberkind, Copenhagen, 1937: 1–180, 8 figs., 28 pls.—The embryology of the balancers in the larvae of three species of salamanders and of the adhesive organs in seven species of frogs and toads is examined in detail. The results show that these organs are not homologous in the Caudata and Salientia, nor with the similar organs in ganoids or lung-fishes, and that their appearance is not in fact of general phylogenetic significance even with these groups. On the other hand, their form and structure is frequently of taxonomic significance. For descriptive purposes, the larval period of salamanders is divided into seven stages, and that of frogs and toads into thirteen. The balancers of salamander larvae are found to serve as supporting organs to prevent sinking into the substratum, as well as for adhesive organs. A frontal adhesive organ, which functions in dissolving the egg membrane, is described in the larva of *Pleurodeles*.

The history of the investigation of the structures in question is fully reviewed. It is appreciated that the investigations should be extended to a more comprehensive selection of material from both groups. The nomenclature employed is anachronistic. The bibliography seems to the reviewer unnecessarily inclusive.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

AXIAL BIFURCATION IN SERPENTS AN HISTORICAL SURVEY OF SERPENT MONSTERS HAVING PART OF THE AXIAL SKELETON DUPLICATED.—By Bert Cunningham. Duke University Press, Durham, N. C., 1937: 116 pp., 12 pls. $2.50.—Dr. Cunningham's book, the contents of which are summarized in the title, reflects a phase of the extraordinary popular interests in teratology, which contributes one of the tribulations of museum curators. The book fills a useful rôle in affording a summary of a considerable, if trivial, literature. It is scholarly in form and make-up, complete with foreword by Dr. Ditmars, bibliography, and index.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

THE BOOK OF WILD PETS. By Clifford B. Moore. G. P. Putnam's Sons, New York, 1937: xiv–553, 314 figs.—This ambitious book devotes eight chapters to the construction and care of home aquaria, including marine aquaria and outdoor pools; four chapters are devoted to keeping reptiles and amphibians in aquaria and terraria; there are two chapters on keeping insects in captivity; four on mammals; and five on birds.

In recent years there has been a notable increase in the popularity of the home aquarium, stimulated in part by the availability of the charming tropical fishes, and reacting in an extraordinary way to make beautiful and odd species available in unexpected variety. This interest is now covered by competent books and journals. The keeping of terraria in this country, especially for amphibians and reptiles, has lagged behind its popularity in Europe. The present book gives well proportioned space to this field, which seems a happy omen. The four chapters in question give sufficiently detailed instruction and advice to forestall many of the questions which would otherwise certainly be addressed to museum curators.

It is unfortunate that the author did not have these chapters edited for him by one of the numerous American herpetologists, who for the most part are quite as generous with their time in such matters as are Mr. Moore's friends in other fields. He could thus have avoided the undue proportion of minor errors which mar his book for the more seriously interested zoologist. There is, for example, a mistake of some sort in sixteen out of the fifty-two scientific names used in the terrarium chapters. The reviewer would have liked some reference to the true chamaeleon, and would like to promote the use of the word "anole" for the American lizard so widely known through its sale at

circuses. The ornate box turtle is figured for the discussion of the eastern species, and the choice of the Sonoran coral snake to illustrate the comment on the "coral snake" is unfortunate. There is a curious editorial indifference to uniformity in the capitalization of the common names of animals. The reviewer would have chosen a somewhat different set of references (p. 211). It is not the *Journal of Mammalogy* which is published in Ann Arbor, but COPEIA (omitted from the list of references). Aldo Leopold's name should have been sufficiently familiar to have been cited correctly. These criticisms do not in the least affect the usefulness of the book to children, and to parents, who like living animals. An index is provided.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

DISSECTION OF THE OPHIDIAN. By David S. Kellicott. General Biological Supply House, Chicago, 1938:1–72, 13 figs. 50 c.—The photographic printing methods, now especially familiar through their use for teaching material and even textbooks, lend themselves especially to the reproduction of out-of-print books and papers of all sorts. The great current interest on the part of the present generation of herpetologists in the accumulation of personal libraries has led the reviewer to coin the terms "pamphletophile" and "pamphletophily"; it is hardly surprising to find widespread interest in the reprinting of various rare herpetological items, which can now be done in facsimile.

Kellicott's booklet on the dissection of the snake, published in 1898 and of course long out of print, is a happy choice for an experiment in this direction, since it combines rarity in the original edition with a considerable degree of usefulness, and is apparently unique as a laboratory manual for the dissection of snakes. Employing the hognosed snake as type, its text follows a normal sequence, discussing osteology, myology, digestive and respiratory systems, the vascular system, the nervous system, and special sense organs. The chapter on the urino-genital system is based on the fox snake. The original figure of the skull was inadequate, and has been supplemented by an excellent newly drawn set of figures. It is to be hoped that the sales of this booklet will warrant further reprinting ventures of this kind.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

DIE FISCHE DER SCHWEIZ. By Paul Steinmann. H. R. Sauerländer & Co., Aarau, Switzerland, 1936: i–viii, 1–147, 45 pls. Sfrs. 12 ($2.75).—This is a handbook, carefully planned for both layman and scientist, on the fishes of Switzerland. It contains a succinct account of the biology of fishes in general, and of the geographic distribution and economic importance of the local species. A simple key precedes the descriptions of the fishes. The latter are illustrated with excellent photographs taken from life. A list of common names is given, and the size range, distinguishing characters, habitat, distribution, life habits, and methods of catching are all outlined on a single page for each fish opposite its photograph. A good bibliography on the fish and fisheries of Switzerland is included.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

DIE ERHALTUNG UND PFLEGE DER FISCHGEWÄSSER. By Ernst Röhler. Handbuch Binnenfischerei Mitteleuropas, 1937: 343–416, figs. 1–59. 9.75 (approx. $3.50). —The author, who spent 20 years in work involving conservation and management of fishing waters, describes in detail the methods used in Germany to prevent the gradual destruction of open water in ponds, lakes, and slow-flowing portions of streams by natural phenomena in which aquatic plants play the chief role. As a basis for understanding the restorative and preventative measures recommended, fully half of the handbook is devoted to a description of the "Entlandung" processes as they occur in the waters of Central Europe. The work is well illustrated with half-tone cuts showing the various types of aquatic vegetation that should be removed as well as the various types of weed pullers, cutters, and scythes that are used to remove encroaching aquatic vegetation. Apparatus for the removal of silt, muck, and other detritus, the secondary factors in the destruction of open water areas, are also described and illustrated.

The discussion, first of all, is from the point of view of a practical fish culturist who is concerned with the food production in water areas much as the agriculturist is concerned with food production on the land areas. Included with this practical view, is the broader view of a naturalist who wishes also to conserve the beauty of his country. In this connection the "Reichsnaturschatzgesetz" (law governing areas preserved in

their natural state) of 1935 is discussed with special reference to the type of conservation work in fishing waters urged throughout the paper.

The author cites, on an economic basis, the value of maintaining and managing fishing waters so that they may continually provide fishing, duck shooting, swimming, and general recreation for the public welfare. He says it is not right to expect individual owners or operators to do more work than would justify their investments and for this reason among others, government aid is recommended. Water, he considers, belongs to the people as a whole and the state must safeguard it for them.

The fallacy that if you leave a lake alone the fishing will become better, is illustrated by an excellent example, which shows that production in fish may be 30 times greater in the same body of water when a definite improvement and management plan is put into effect. This statement is highly significant in relation to present-day experimental stream and lake improvement work being carried on in the United States.

The discussion takes a further practical turn in the section devoted to the uses to which materials removed from the water may be put; for example, in the manufacture of fertilizer. These uses repay, in part at least, the cost of clearing waters of encroaching materials and must be taken into account.

The author stresses the importance of prevention as much easier than the cure. If in summer the denser weed-beds are cleaned out, for the present at least, encroachments are brought to a halt. He warns against the belief that occluded water areas readily become productive meadows, and criticizes the expenditures of both effort and funds in attempting to change swamps into productive land areas without due regard to their possible value as improved water areas.

In the concluding section is discussed the persons or agencies best fitted to carry on the work outlined. The division of labor between fisheries workers and foresters is well defined. Also of interest is the discussion relating to the use of labor units organized by the present German government.

This is a most illuminating and well-written document, particularly so in light of the present trends in this country toward erosion and flood control. In America the tendencies to date have been almost entirely in preservation of the land. Little thought has been given to the preservation of water areas, in spite of the fact that we know lakes and ponds to be but temporary phenomena. Beyond reflooding former wet areas for duck refuges and shooting grounds, we have yet to follow the Germans in prevention of the "Verlandung," or filling-in process, in our inland waters.—P. R. NEEDHAM, *Natural History Museum, Stanford University, California.*

ATLANTIC GAME FISHING, by S. Kipp Farrington, Jr. Kennedy Bros. Inc., New York, 1937: i–xxii, 1–298, color plates, 132 halftones. This beautifully printed book on Atlantic big game fish and fishing is entertainingly written for sportsmen; but ichthyologists will find much useful information which was obtained in the field about broadbill swordfish, tuna, bonito, white marlin, blue marlin, wahoo, sharks, and other large game fishes. Numerous photographs of specimens while still on the line and after being landed are reproduced. A chapter of 32 pages is devoted to fishing tackle and the ethics of the game. There is an index.—LEONARD P. SCHULTZ, *National Museum, Washington, D. C.*

INTERNATIONAL ASPECTS OF OCEANOGRAPHY, OCEANOGRAPHIC DATA AND PROVISIONS FOR OCEANOGRAPHIC RESEARCH. By Thomas Wayland Vaughn and others. National Academy of Sciences, Washington, D. C., 1937: i–xvii, 1–225, 36 pls., 10 text-figs.—Here is a digest, mostly in tabular and graphic form, of the present status of physical oceanographic research. References are given to all known sources of data on this subject for all the oceans, and a comprehensive series of charts are presented showing all locations to which published observations refer. The work thus serves not only as a guide to literature, but calls attention to the areas of the sea most in need of exploration.

A catalogue of oceanographic institutions of the world is included to show for each country its provisions for oceanographic research and the scope of its activities in this field. For each institution a brief account of its history is given, as well as a statement describing its organization, purposes, scope of activities, equipment, etc. Obviously this is a reference work that should be readily available to all students whose work even remotely impinges on oceanography.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

EDITORIAL NOTES AND NEWS

Fourth Edition of Reptile-Amphibian Check List

A FOURTH edition of the *Check List of Reptiles and Amphibians from North America* is contemplated. Persons who have in manuscript notes concerning the systematics or distribution of North American reptiles and amphibians would confer a favor on the authors of the Check List by publishing promptly.

Annual Meeting

THE LOCAL COMMITTEE for the annual meeting of the Society, to be held at Berkeley, California, July 20–23, is to be congratulated for the able assistance offered to members planning to attend. Full information about travel routes may be secured from MARGARET STOREY, Box 1606, Stanford University, California. The Pacific Division of the American Association for the Advancement of Science will meet in San Diego, June 20–25. Special events are planned at San Diego for visiting members of our Society, including a night desert collecting trip.

Endowment Fund

THE following persons have become partial life members since the last number of COPEIA appeared: SARAH ROGERS ATSATT, C. M. BREDER, JR., WM. M. MANN, B. PRASHAD, CLARENCE TARZWELL. The total sum on deposit in the Endowment Fund is now $965.38. In addition, the treasurer reports that the profit to the Society on the sale of Wildlife Stamps will probably amount approximately to $100 when the complete returns are available. This sum will be added to the Endowment Fund.

Award

DR. WILLIAM M. MANN and MRS. LUCILE MANN have been awarded the Franklin L. Burr Prize of $1000 in recognition of the success of their biological expedition to the Netherlands Indies last year. This award is made by the National Geographic Society to those members of the society's expeditions considered by the Board of Trustees to have accomplished "especially meritorious work in the field of geographic science."

Aid to Copeia

FINANCIAL aid in the publishing of this issue of COPEIA has been received from MAJOR CHAPMAN GRANT and WILFORD A. DENCE.

News of Herpetologists

ARTHUR LOVERIDGE, of the Museum of Comparative Zoology, has been awarded a Guggenheim fellowship for further investigations in Africa. Mr. Loveridge leaves in September to spend a year in Africa.

KARL P. SCHMIDT, of the Field Museum, accompanied by his son John and C. M. Barber, made a brief collecting trip to the Ouachita Mountains in western Arkansas in March.

MAJOR CHAPMAN GRANT continued his investigations of the Jamaican herpetological fauna during March and April.

DR. E. R. DUNN has been appointed Associate Curator of the Division of Reptiles by the Philadelphia Academy of Sciences. Dr. Dunn will continue to teach at Haverford.

DR. DORIS COCHRAN has received one of the grants-in-aid for foreign travel and study made by the American Association of Museums from a fund provided by the Carnegie Corporation of New York. Dr. Cochran plans to visit foreign museums in September.

Ichthyological News Items

DR. FREDERICK KOUMANS, of Leiden, Holland, author of *A preliminary revision of the genera of the Gobioid fishes with united ventral fins* (1931), is continuing his study of this large and difficult group, particularly from the Indo-Pacific as bearing on the forthcoming volume of Weber and de Beaufort's Indo-Australian fishes, in which it will be treated. Dr. Koumans, accompanied by the Dutch biologist G. Knock, is at present on a world tour. March and April were spent in the United States, examining type material in various museums.

DR. MYRON GORDON has completed twelve years of study of the genetics and spontaneous heritable neoplasms in fishes at Cornell University. The histological study of the neoplasms, left unfinished by the late Dr. H. D. Reed, will be completed by Dr. G. M. Smith, of Yale University, and Dr. Gordon. This work has been made possible by a grant from the International Cancer Research Foundation of Philadelphia. Dr. Gordon has been awarded a Guggenheim fellowship for the coming year, beginning in September, 1938, to continue his researches on the genetics of Mexican fishes.

DR. E. W. GUDGER, Bibliographer and Associate Curator of Ichthology in the American Museum, has been retired with the title of Honorary Associate in Ichthyology. He will remain at the museum to complete the *Dean Memorial Volume,* and will continue his research there.

DR. E. B. WORTHINGTON, well known for his work on the fresh-water fishes of the great lakes of Africa, has been appointed Director of the Fresh-water Biological Association of the British Empire, with headquarters at Wray Castle, Ambleside, Westmorland, England.

DR. LEONARD P. SCHULTZ has been promoted from Assistant Curator to Curator of Fishes in the United States National Museum.

DR. LORE DAVID, a general ichthyologist, formerly connected with the Senckenberg Museum and with the Belgian Congo Museum at Brussels, is temporarily residing at 325 S. Craig Ave., Pasadena, California, and is seeking a position in America.

DR. V. D. VLADYKOV, who has been working on the biology of striped bass for the Maryland Conservation Commission, is now on the Zoology staff of the University of Montreal.

DR. ROBERT C. MILLER, of the Department of Zoology, University of Washington, has been appointed Director of the Museum and of the Steinhart Aquarium of the California Academy of Sciences, beginning September 1.

DR. RUDOLPHO VON IHERING has been appointed Director of the newly-established Servico Nacional de Pisciculture of Brazil, with headquarters in Rio de Janeiro (Caixa Postal 334). He is planning to equip two new fisheries laboratories, one in Sao Paulo and the other in Rio Grande do Sul. The position of Director of the Commissao Technica de Pisciculture of northeastern Brazil, with headquarters at Fortaleza, Ceára, has been taken over by DR. PEDRO DE AZEVEDO.

Fisheries Research and Conservation

THE NEW YORK DIVISION OF FISH AND GAME held a conference on February 8 at the New York Aquarium, where plans were laid for an investigation of young fish populations in the bays and inshore coastal waters of Long Island throughout the summer months. Information on the abundance, survival, and growth of young fish will be collected and compared with similar studies of adults of the same species. Both sports and commercial fishes will be covered by the survey. Among those attending the conference were Emmeline Moore, John R. Greeley, A. E. Parr, John Nichols, C. W. Coates, C. M. Breder, Jr. and W. C. Neville.

Plans have been made for the construction at the Lake of the Woods in Minnesota, of a hatchery for pike. The establishment, which is to have a capacity of 200,000,000 fry, is to be operated jointly by a fishermen's cooperative association and the Minnesota Department of Conservation.

The third annual North American Wildlife Conference was held in Baltimore, February 14 to 17.

The inland fisheries research program of the CALIFORNIA DIVISION OF FISH AND GAME has been reorganized and augmented by a plan whereby the state will be divided into districts with a biologist studying the general problems of the district and also some special problem of the state as a whole.

BRIAN CURTIS, who has been engaged in independent research at the American Museum of Natural History and at Stanford University, and WILLIAM A. DILL, who has been on the teaching staff of Santa Clara University since 1932, and also engaged in a study of the life history of the sand dab at the Hopkins Marine Station of Stanford University, have joined the staff of the Bureau of Fish Conservation in the capacity of Senior Inland Water Fish Researchers. Mr. Curtis will serve as biologist for the central Sierra district and will engage in a study of angling statistics. Mr. Dill will serve as biologist for the southern Sierra district and will engage in a study of the intra-relationships of the game and non-game fishes.

JOSEPH H. WALES will continue his disease and nutritional studies and act as biologist for the northern Sierra and upper Sacramento drainages. MERRILL BROWN will continue in charge of fish rescue and reclamation work and of the Central Valleys Hatchery for propagation of spiny-rayed fishes, and will act as district biologist for the Central Valleys. LEO SHAPOVALOV will serve as biologist for the coastal streams and will continue to supervise the stream and lake survey.

The general inland fisheries research program will be under the supervision of ALAN C. TAFT, Chief of the Bureau of Fish Conservation.

Journal of Marine Research

THE establishment of a new journal often receives a mixed reception as there are many who feel that there are already too many publications. However, the *Journal of Marine Research* should feel no concern on such a score for it should be welcomed by all who are interested in problems relating to the sea. Although there are journals suitable for papers in Marine Biology—most of the Institutions concerned with Oceanography have their own for the publication of data and lengthy descriptive articles, there has been until now no domestic journal suitable for the publication of papers dealing with theoretical problems, particularly in the field of Physical Oceanography. *The Journal of Marine Research* intends to lay emphasis on theoretical problems of all phases of Oceanography, biological as well as physical. Furthermore the journal will accept papers in Physical Meteorology, particularly when these deal in part at least with the relation of the atmosphere to the ocean and where the two sciences are related by interest in common problems.

The journal is published by the Sears Foundation for Marine Research, Bingham Oceanographic Laboratory, Yale University. A. E. PARR of Yale University is the Managing Editor, and the following are on the Board of Editors: C. G. ROSSBY, H. U. SVERDRUP and T. G. THOMPSON. The journal will be published three times a year.

The first issue has a paper by H. U. Sverdrup *On the Evaporation from the Oceans* in which a method for the computation of evaporation from the humidity gradient and wind velocity is presented. C. G. Rossby discusses certain properties of currents from a theoretical point of view in a paper entitled *On the Mutual Adjustment of Pressure and Velocity Distribution in Certain Simple Current Systems.* A. F. Spilhaus in a *Note on the Flow of Streams in a Rotating System* presents the results of certain experimental studies. Lyman D. Phifer and Thomas G. Thompson present a study of *Seasonal Variations of San Juan Channel during the Five Year Period, January 1931 to December 30, 1935.* Gordon A. Riley discusses the amount of various plant nutrients contributed to the sea by the Mississippi in a paper entitled *The Significance of the Mississippi River Drainage for the Biological Conditions in the Northern Gulf of Mexico.* Martin D. Burkenroad has contributed a paper on *The Sex Ratio in Alternational Hermaphrodites, with Especial Reference to the Determination of Rate of Reversal of Sexual Phase in Oviparous Oysters.*—RICHARD H. FLEMING, *Scripps Institution of Oceanography, La Jolla, California.*

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